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CONTENTS.

	PAGE.
ILLUSTRATED ARTICLES:	
Electric Railways—VII	13
The Excelsior Electro-Plating Dynamos	15
Hall's Electric Locomotive of 1850	16
A Chronological Record of Expiring Electric Motor Patents	17
EDITORIAL:	
Paragraphs	11
Electric Railway Propulsion	11
MISCELLANEOUS:	
The Overland Telephone Suits	11
A Review of Electrical Events and Progress in 1884 (continued)	12
Baltimore & Ohio Extension and Reduction	12
An Underground Company in Straits	12
English Experts on Underground Wires	13
MISCELLANEOUS:	
Prof. S. P. Thompson	14
Notes on Paraffin Insulation	16
Blake's New Transmitter	16
The Magnet as a Hypnoscope	17
Blind Telegraph Messages	17
A Chat about Units and Their Meaning	18
Characteristics of Lightning Strokes	18
The American Electrical Exhibition	18
Electric Facts from New Zealand	18
Hell-Gate Light	19
Criticising the Critique	19
DEPARTMENTS:	
The Telegraph	19
The Telephone	19
The Electric Light	19
Miscellaneous Notes	20
Applications of Powers	20
Stock Quotations	20
Our Illustrated Record of Electrical Patents	20

New Advertisements.

The Butler Hard Rubber Co.—Electrical Supplies iii
Boulton Carbon Works—Carbon iii
The New York Electric Co.—Portable Gas-Lighter iv
Lock Box 5, Garrison, Ia.—Position Wanted v
"South"—Experienced Man Wanted v
E. Hiltebrand—Primers of Electricity v
American Underground Electric Wire Co.—Underground Wires v
W. J. Johnston—"Dredge's Electric Illumination" v
New England Machine Co.—Steam Engines viii

REARRANGED ADVERTISEMENTS.

New York Safety Steam Power Co.—Steam Engines i
Tropical American Telephone Co.—Telephones for Export ii

Vol. V. NEW YORK, JAN. 10, 1885. No. 2.

LT. MILLIS, of the Engineers, calls our attention to the fact that to the Lighthouse Establishment is due the credit of the successful installation at Hell Gate. We take pleasure in publishing his letter on this point.

CHINA'S fight with France is showing that the Celestials are not to be despised as adversaries, and that they appreciate at the full value many of the improvements of modern civilization. In their naval and military services they are making use of electrical appliances, and in a report on proposed roads and telegraphs for the Flowery Kingdom General Low-Mung-Chin expresses the opinion that a telegraphic line along the coast is an "urgent essential." It is said that high Chinese officials make constant use of the lines that exist in the empire.

THE youth of England appear to take kindly to instruction in electrical engineering. The school of Submarine Telegraphy and Electrical Engineering, Prince's street, Hanover square, London, of which we gave lately a detailed description, is prospering, and bids fair to become more and more prominent in scientific education. Mr. W. N. Tiddy now has associated with him Mr. W. Lant Carpenter, whose admirable work on "Energy in Nature" we reviewed a few months ago. The course has been extended to 12 months and the fee raised to 100 guineas ($500). It seems to us that many an American parent who now sends his boy to German seats of learning to be disqualified for the practical life of this country, would do better in giving him such a chance as this, fitting him for an honorable position in a growing profession.

WE are indebted to Mr. Angus McCurdy, Wellington, N. Z., for the very interesting statistics published in this issue respecting the electrical progress of the young British colony of New Zealand. Mr. McCurdy has managed to compress a vast quantity of information into his summary, and places his fellow colonists in a very favorable light before the American electrical public. It is evident that there is no lack of enterprise in the New England at the antipodes. Mr. McCurdy kindly sends us also a photographic view of the Post and Telegraph office at Wellington, erected during 1884, and intended to serve as the chief office of the Colony. It is a beautiful building, classic in line, solidly constructed, surmounted by a fine clock tower, and distantly resembling—if a comparison be wanted—the City Hall of New York. It faces the water-front, and must be a conspicuous object in the view. We congratulate our electrical friends in New Zealand on the growth the profession shows there.

WE have read somewhere that when the superstitious people living along the banks of the Thames saw the first steamboat churning its way down the river from London, against wind and tide, they shouted curses on the heads of the men who were thus flying in the face of Providence. Innovation has always had this kind of opposition to deal with, and of course the electric light has been objected to as in some sense sacrilegious. We are a little surprised, however, to note that a recent number of the *Moniteur de Rome* publishes an authoritative publication from the Sacred Congregation of Rites to the effect that the electric light and the baskets of artificial flowers suspended from the arches, as was done for the recent centenary of St. Damascus, are in nowise suitable to the sanctity of Christian temples. This warning is intended to prevent in the future any similar unbefitting ornamentation, whether in Rome or elsewhere. Apparently the chief objection there to the electric light is that it is in the bad company of the flower baskets, but it must be borne in mind that a conscientious glow or arc lamp would scorn to shine with "a dim religious light."

ACCIDENTS in the use of gas continue to occur with remarkable frequency, but we look in vain for articles about them in the papers that preach about the supposed dangers of electric lighting. As many as three or four items on the subject crop out daily, but, in the language of the poem on the Jackdaw of Rheims, "the gas companies do not appear to be a penny the worse." Recently a house was wrecked at Montreal by an explosion resulting from leakage. On Sunday last, a gas leak at Utica, N. Y., caused the total destruction of a mill; loss, $100,000. On Tuesday, a gasfitter applied a light to an uncapped pipe in a large store in the dry-goods district of this city, and the damage to the building and the stock of the various occupants is put at not less than $40,000. The same day, four boys started a little fire near a leaky pipe in a carpenter's cellar in this city, and a big explosion was the result, with damage to property and injury to person. New Year's Eve, a raw Irish girl was nearly suffocated by escaping gas in a New York hotel, and since then the death of an Englishman has been caused by gas at the Ashland House. This list is far from complete for the period it covers.

IN presenting to the readers of THE ELECTRICAL WORLD the results of considerable research among the records of the Patent Office relating to electric motor patents—see page 17—it may not be out of place to recall briefly the advantages which flow from the operation of patent laws, for the benefit of the public. As the patents for these devices have all expired, they are free to be used, in whole or in part, without fear of infringement or other legal complications. Being a chronological and complete record of all American patents relating to motors, which have become public property, these papers possess peculiar value for the electrical engineer or the electrical manufacturer, as showing to what extent he may employ the ideas of American inventors without rendering himself liable to litigation. To the designer of new machinery, these articles, as far as the American patent records are concerned, show what patentable feature, if any, he may employ in construction. The papers will be found to be of special interest to electricians at the present time in view of the important negotiations and combinations taking place among the electric railway interests of the United States, and also in view of the attention that electricians are giving to the manufacture of motors for light work, such as is done by sewing machines, dental lathes and the like.

ELECTRIC RAILWAY PROPULSION.

The prominence which electric railway propulsion is attaining in public consideration makes some notice of the leading systems now in the field quite in order. The recent conference for determining the selection and application of a system for the elevated railways of New York brought forward a number of competitors, but among so many *cordons bleus* the lamb—as was perhaps to have been expected—seems to have suffered.

Electric propulsion has certainly proved itself practicable abroad—and at home to a limited extent—but when so vast an enterprise as changing the equipment of the elevated railways of New York City is contemplated, the boldest innovator will proceed with caution. It ought to be more a matter of surprise than it is that capitalists are so ready to hazard enormous sums of money on new and unproven schemes. This perhaps was never so forcibly exemplified as during the inception of submarine telegraphy, but it also appears to some degree in the present case; not enough, unfortunately, to prompt that "first step which costs." It must be confessed in all frankness that the capitalist's position is not an easy one. It cannot but be sorely perplexing to weigh and compare the claims of rival inventors, all of whom may be intellectual and moral peers, and yet as diametrically opposed in technical belief as the poles. "Who shall decide when doctors disagree?"

The natural recourse is disinterested scientific opinion, and perhaps it is the only one; but when it must be admitted that the crucial test of a new invention is not so much one which can be accomplished by applying instruments, or be expressed in conventional units, as that of prolonged use and trial under all conditions of actual service, it becomes readily apparent that expert examination and opinion of a novelty can rarely, if ever, be more than partial. The verdict must generally be given with reference to collateral evidence, of which a sagacious man of affairs is perhaps more competent to judge than the technologist.

This in nowise asserts that commercial tests may not be made which will be conclusive and final. If the cost is justifiable, they are always obtainable, but in the majority of cases the *res angusta domi* obtrude, and this seems to have been the reason why the recent electro-motive conference arrived at no practical end.

The systems represented at this conference were practically four, viz., the Siemens, the Edison-Field, the Daft and the Brush-Bentley-Knight—each and all fortified with argument and demonstration. The Daft, however, seemed to be most fully possessed of the courage of its convictions, as it, and it alone, professed to be ready for immediate negotiation, and able to have an electric motor doing regular service on the line within forty days.

In view of this promptitude, and also of the fact that the first part of this year will see it in full operation on the Brooklyn Bridge—a test which, considering grades and continuity of service, is probably as severe as any that could be devised—it has merited especial notice at this particular juncture. We have, therefore, given to-day some illustrations and facts in regard to it, in the seventh of our series of articles on electric railways.

The Overland Telephone Suits.

The American Bell Telephone Company's cases against the Overland telephone companies of Pennsylvania, Delaware and New Jersey, which were brought over a year ago in the United States Circuit Court, for the purpose of preventing the defendant companies from using a transmitter and receiver in telephone instruments alleged to be infringements on the Bell patents, were argued at great length in January last before Judges McKennan, Butler and Nixon. The court, however, declined to give a decision upon the motion which had been made on behalf of the complainants for a preliminary injunction to restrain the defendants from making the alleged infringements, inasmuch as a case was then pending in New York which involved the same question. Last week the numerous counsel represented in the case appeared before Judge Butler, of Pennsylvania, and Judge Nixon, of New Jersey, when it was stated that as the New York case had been decided in favor of the Bell patents, the counsel for the Bell Company desired to call up the long-pending motion for a preliminary injunction in the suits. The court stated that it did not wish to hear the arguments over again, but it would give counsel additional time if they had anything new to present. It was stated that additional exhibits would be offered, and January 7 was fixed for calling up the cases.

A London Idea.—The *Electrician*, of England, says: It is proposed to establish in London a system of "cab call and police and fire communication," by means of a dial placed in the hall of a subscriber, connected with another at the nearest rank, a third at the fire brigade depot, and a fourth at the police station. Capt. Shaw has reported favorably on the scheme, and a company has been formed to work it.

Items from Evansville, Ind.—The Evansville District Telegraph Company have taken a contract from that city to furnish them with a complete police and fire patrol signal system. Mr. Henry B. Ingram, an accomplished electrician, formerly superintendent of the Messenger Department of the Manhattan District Telegraph Company of this city, is the superintendent, and will have entire control over the system.

A Review of Electrical Events and Progress in 1884.

Pursuing our review of the year we come to

THE ELECTRIC LIGHT.

In this field the advance has been steady, speaking commercially, although scientifically no new features of importance have been brought under observation. Work has gone on methodically in the direction of improving details in the construction of dynamos and lamps and perfecting the arrangements for the distribution of the current. It would be difficult to enumerate, with particulars, the installations begun or completed during the year. In New York we have seen a large extension of the area lighted by arc lamps under city contract, and the Edison Company has had applications throughout the year for more customers than it could supply house-to-house outfits. The lighting of the great Brooklyn Bridge with Weston arc lamps has proved an immense success, and the trustees of the structure have taken over the plant from the United States Company, which had been operating it on trial. The brilliant illumination of the Bridge in all weathers is no mean achievement, and, as it could be accomplished by no other means, shows the incontestable superiority of electricity. But, as if to exemplify the variety of uses to which the light could be put, another extraordinary installation has just been finished at Hell Gate, where a circle of large Brush lamps, at a height of 250 feet in the air, surmounting a huge skeleton tower, shed their brilliant light upon the East River. A third notable installation is that at the magnificent Mutual Life Insurance Building, right in the heart of this city, where the Consolidated Electric Light Co. have about 2,000 Sawyer-Man lamps in circuit, demonstrating beyond cavil the practical manner in which the incandescent light can be employed in the largest buildings, without any dependence whatever on gas as an auxiliary. The city of Brooklyn saw two companies start into existence during the year, and the result of their operations is that the beautiful Thomson-Houston lights now burn nightly in every part of that large community. At Boston, a station to operate 1,000 of the same lights was started in March by the Merchants' Electric Light and Power Company. A notable Van Depoele installation was completed at Elgin, Illinois. Electric lights were in demand for nearly every fair or exhibition held in the country; but the requirements of the New Orleans Exposition eclipsed every precedent, and hundreds of Thomson-Houston, Excelsior, Brush and Jenney arc lights, with 15,000 Edison incandescent lights, illuminate this latest and biggest world's fair.

Considerable attention was bestowed at the International Electrical Exhibition, Philadelphia, on the new "mammoth" incandescent lamps invented by Mr. Weston. These lamps were burning in different parts of the building, and their light was pronounced by all who visited the exhibition to be extremely pleasant and satisfactory. Some persons are of opinion that these mammoth lamps are destined to take the place of arc lamps for certain purposes. Mr. Edison also exhibited lamps of the same kind.

Among new uses of the light may be mentioned the dropping of an incandescent lamp into whiskey, in order to "age" it rapidly. At Chicago an installation was made of 330 arc lamps to light up a new driving park, and in various parts of the country, during the summer, sports have been carried on at night with the aid of arc lights, in order to avoid the glare and heat of the day. The number of arc lamps in use throughout the United States now is over 90,000, and the incandescent lamps must number twice as many.

APPLICATIONS OF POWER.

In times of depression one does not look for much new work, but, despite the financial troubles of 1884, various attempts to transmit power electrically were made with success, and the discussion of the subject assumed remarkable proportions. At the Philadelphia Electrical Exhibition the regular edition of THE ELECTRICAL WORLD was printed on a Cottrell press driven by a Daft motor for six weeks, from electrotypes, and several other motors, such as the Sprague, the Stockwell, the Weston, the Brush, the Ayrton & Perry, and the Van Depoele were shown in operation. During the year the Daft Electric Light Co., of New York, built two electric railways, which were operated for commercial purposes, with marked success. One at Coney Island, on the West Brighton Pier, was running for 71 days, and carried 37,500 paying passengers on a mileage of about 1,000 miles. This was an outdoor track. The locomotive weighed only 1,200 lbs. The other railway was constructed in the building of the Mechanics' Charitable Association, Boston, and carried about 30,000 people while the fair there lasted. It is noticeable that at Boston the experiment continued for 41 days, and that the trip of 700 feet, made 125 times a day, was made to include three starts, three stops and two reversals. A railway was operated at the Philadelphia Exhibition by a Griscom motor and Weston dynamo, and the Bidwell electric railway, also in operation there, was carried to Boston and started again with success at the American Electrical Exhibition there. As the year closed, a company with a capital of $200,000 was formed to operate an electric railway at Far Rockaway, the well known seaside resort.

Toward the end of the year, the desirability of applying electricity to the elevated roads of New York became the theme of constant discussion in the papers, and an endeavor was made to consolidate the various electromotor interests, so as to place all the resources of the art in the management and under the control of one company. The interests represented in the negotiations were the Daft, Edison, Field, Siemens and Bentley-Knight (Brush). Although some kind of company has been formed, the proposed consolidation must be characterized as a failure, and the beginning of January finds the matter practically as it was before the conferences began. No tests have yet been made on the elevated roads, though there is still promise of them.

The Daft Company obtained permission to operate on the Brooklyn Bridge tracks, and made its preparations to begin running early in 1885. The frequent failures of the cable system during the past year have led to the general belief that sooner or later electricity will be resorted to.

Not the least interesting scheme discussed during the year was that to use electric motors on the projected underground road in Broadway, New York. The engineering and electrical details of the plan were explained and illustrated in these pages. The advantages offered by it to New Yorkers are too numerous to allow it to remain long in the discussion stage.

The Van Depeole system was used with success on a short road at Toronto, Can.

OCEAN CABLES.

The year witnessed the laying of two more cables between the United States and the Old World. The dissatisfaction of the New York *Herald* with the rates and service of the old cables was an open secret, and no great surprise was occasioned, therefore, by the efforts of Mr. Bennett to obtain a cable chiefly for his own use. Joining hands with Mr. John W. Mackay, the millionaire, already interested in the Postal Telegraph Company, Mr. Bennett was soon able to form the Commercial Cable Company, and by the middle of the year the "Faraday" was at work laying the first of the two cables for the promoters of the new enterprise. The cables were made by the Messrs. Siemens, at their factory near London, and their total length is over 6,000 miles. The work of laying went along smoothly, but no sooner was it completed than both cables were broken, although they were unquestionably stronger than any ever made before. This was a sad disappointment to all concerned, but at last repairs were effected, and by the end of the year the system was in operation. We published a map of the routes of these cables. It is to be noted that a new departure was made in bringing the end of one cable directly into New York, and by using the Muirhead duplex arrangement. The New York cable, after running down the coast from Nova Scotia, lands at Coney Island, is brought through Brooklyn, underground, and then is strung across the Bridge, and thence is carried underground again to the very door of the Stock Exchange. The other cable lands at Cape Ann, and serves Boston and the Eastern States direct. Supplementary to the cables the company has built a fine repairing steamer of 1,500 tons and 1,400 horse-power, to steam eleven knots per hour.

Beginning work on Christmas Eve, the Commercial Company at once obtained a good share of business at a rate of 40 cents per word, cutting under the old tariff of the "cable pool" controlled by Mr. Gould and Mr. Pender. The other cable companies at once responded by meeting the "cut," and the indications are that the fight will be prolonged. The new cables have the support of the Baltimore & Ohio Telegraph Company, as well as of the Postal Company, and while business men have been quick to appreciate the efficient service of the Commercial Cables, the *Herald* has shown a determination to make good any possible deficiencies by using the new opportunities very freely. It is reported that attempts have been made to get the new company into the pool.

The Gould cables were broken during the year, and the Western Union Telegraph Company opened a very fine and ornate cable office in Broad street. Of two or three other cable schemes proposed early in 1881, nothing has since been heard. The New York *Times* spent considerable sums on cabling, one dispatch from Spain costing, for transmission alone, over $4,000. Several papers established the practice of receiving regular cable letters from their European correspondents. The extension of cable facilities between this country and South America was largely availed of by merchants.

[TO BE CONTINUED.]

Telephone Stocks.—A general summary of the markets in telephone stocks show Erie telephone shares official October returns:

Gross earnings	$47,701.16
Expenses	28 988.17
Net earnings	18,712.99
Construction	6,341.21
Surplus	12,371.78

The estimated earnings for November show an increase over these figures. The Mexican Company appears to have suffered somewhat from the general depression in Mexico, but still shows some growth in the number of instruments in use. It more than pays expenses, and also, it is believed, for construction, leaving a small surplus. The victory of the Bell Telephone Company over the Drawbaugh Company was a benefit to all companies using the Bell instruments, but less to the Mexican than most others, as it could obtain instruments of any other make if necessary. Mexican stock did not rise with the others because buyers were lacking; why they were lacking is purely a matter for conjecture.

Baltimore & Ohio Extension and Reduction.

The year 1884 has been rendered memorable in telegraphic history by the Baltimore & Ohio Telegraph Company, through its enterprise in the construction of the greatest number of miles of wire ever known within a period of twelve months and its prompt meeting of public demands by reduction of rates. At the opening of the year the mileage of the B. & O. T. Co. was less than twenty thousand. It is now forty-seven thousand, no less than twenty-eight thousand miles having been strung from January 1 to December 31. A majority of the new extensions are of large gauge galvanized iron wire, with over 4,000 miles of hard-drawn copper wire, which is as much an advancement upon the old-time material as is the substitution of steel for iron on railroads. The Baltimore & Ohio signalizes the new year with a wholesale reduction of telegraphic rates to all the great commercial centres within its extensive system.

From New England cities the rate to this city under the new schedule is ten cents for ten words, and but twenty-five cents to all prominent Western cities, where a year ago it was from forty to sixty cents. From Philadelphia, Baltimore and Washington the old fifteen cent rate to this city is reduced to ten cents, and to other points both West and East—to wit, Chicago, Cincinnati, Pittsburgh, Cleveland, Columbus, Indianapolis, Boston and New England cities generally—twenty cents, a drop ranging from thirty to fifty cents. From Chicago in all directions the new year marks a swath cut in former tariffs—fifteen cents instead of fifty to New York; the same to Cincinnati, instead of thirty-five; twenty to St. Louis; a hundred and fifty per cent. less to Philadelphia, Baltimore and Washington, or twenty cents, as against fifty; one-half the old rate to Pittsburgh and Columbus, and very nearly as great a reduction to Cleveland and Indianapolis, all these cities coming within the twenty cent rate. Five cents more takes in all ten word messages from Chicago to Boston, Providence, Hartford and the New England cities, where the old schedule called for from sixty to seventy-five cents. The night rate goes down everywhere to the uniform figure of fifteen cents for fifteen words, whereas a year since it was one-half the day or full rate, with the stipulation that all such messages must not be less than twenty-five cents. Another innovation is the uniform rate of ten cents between all city offices.

The extensions being made within the southern systems of the Baltimore & Ohio Company are now nearly completed, and the offices in New Orleans, Galveston and other leading cities South will be opened by February 1. This will give the benefits of strong and lasting competition to a large section not hitherto enjoying them. The enormous reduction made by the Baltimore & Ohio Company will have a direct bearing upon foreign dispatches, the intimate connection effected with the new cable lines of the Commercial Cable Company, which has decreased its ocean tolls twenty per cent., affording direct access to all European cities at the low rates. The new cable company, like the Baltimore & Ohio Telegraph, is beyond the reach of those who would absorb the telegraph systems of the world.

An Underground Company in Straits.

The property of the Philadelphia Sectional Underground Company, which was announced to be sold by the sheriff on the 5th instant, has been postponed by Judge Finletter granting a stay of proceedings on the application of the company. On the 13th of last March the company gave a four months' note to Davis & Harvey, iron manufacturers, of Catasauqua, in payment for the iron conduits. The note amounted to $5,699.12, and with the interest charges it now amounts to considerably more than that sum. When the note became due it was protested, and legal proceedings were begun by the iron firm to compel payment. Judgment was obtained, and a date fixed for a sale of the effects by the sheriff, but at the request of the company a stay of two months was granted in order that they might collect funds to liquidate the debt. At the expiration of the time the company failed to make payment, and the firm proceeded with the matter by obtaining judgment for the full amount.

The most important piece of property belonging to the concern is said to be the conduit which extends from Third to Broad streets on Chestnut, with a branch to the Public Buildings and another down Eleventh street a short distance. This conduit has been leased to and is now operated by the Electric Light and Power Company, which corporation is said to be controlled by men largely interested in the Underground Company. The councils have granted to the Underground Company the right to lay conduits on Chestnut street, and this franchise is regarded as one of the most valuable assets of the company. The conduit and city franchises are estimated to be worth much more than the amount of the iron firm's claim, and it is intimated that the matter will be arranged before it comes to a sale.

In Scotland.—The electric light lately furnished the Glasgow Post-Office was by no means satisfactory, and the contract of the old company having expired, another brand is to be tried, the manufacturers of which are making extensive alterations before turning on the current, by putting all conductors out of sight under the flooring, and moving the engines and dynamo machines from the building to an outside station. The contract is for five years.

Electric Railways.—VII.

Our readers have already been informed through these columns of the project on foot to supplant the use of steam, on the elevated railroads of this city, by electricity, and while as yet nothing definite has been decided, the mere fact of its having been proposed shows to what large extent the idea of electric locomotion may be carried out in this city alone. It is apparent that the elevated roads present peculiar advantages for the application of such a system. Among the most prominent of the systems brought forward in that connection is that of Mr. Leo Daft, of the Daft Electric Light Co. This gentleman's electro-motors are well and favorably known, and we need only to point to our exhibit at the late Electrical Exhibition to demonstrate their general applicability. The question of electric locomotion has long occupied Mr. Daft's attention, and as a result thereof a complete system has been devised by him, which has already proved a practical success, but which, under the improvements it is now undergoing, is destined to see shortly a wide extension.

It is now more than a year since the first public trial of this system was made at Saratoga, N. Y., and our illustration shows the locomotive "Ampère" attached to a regular passenger car of the Saratoga, Mt. McGregor and Lake George R. R., upon which it was tried. During a visit which we recently had the pleasure of paying Mr. Daft at his works, we saw the "Ampère" exactly as it appeared at Saratoga, and a ride aboard of it gave us a very favorable impression of the ease and effectiveness with which it can be handled.

It must be understood, in the first place, that the Daft system comes under the three rail category of electric railways, so that the only requisite to adapt it to existing roads is the laying of a central insulated rail; through this central rail the current is led to the motor, and is returned by either one or both of the outer rails.

iron wire is employed in the outer coils of the field magnets so as to obtain the required resistance without too greatly exceeding the magnetic limit.

The brakes of the "Ampère" are controlled by the third switch shown, and a mere turn of the hand causes them to act with any required degree of intensity. The brakes themselves are of the so-called "pendulum" type. As will be seen, they are suspended from the frame of the car and swing freely on a bolt passed through an eye at their upper ends. The suspended frame carries an electro-magnet wound with stout wire, and when the current is switched into the latter the magnet immediately follows the attraction of the wheel, pressing against it and exerting a powerful grip. Situated at the side of the driver there will also be seen a lever, by means of which the locomotive can be sent forward or reversed at will. This is accomplished through the medium of four brushes arranged about the commutator and placed equidistantly apart. The lever has two rods at its lower extremity, which connect with two brushes each, and by this means either pair can be put in contact with the commutator with the result above mentioned.

From the above description it will be seen that the locomotive presents all the features of a well-executed system, and some details of the test at Saratoga, mentioned above, will therefore prove of interest. On that occasion the track upon which the "Ampère" ran was about 1¼ miles long, being part of the main track of the Saratoga & McGregor R. R., and included a very sharp curve and grade combined, about one mile away from the starting point. The track was laid with 35-lb. rails, in addition to which a central track of similar rails was laid upon blocks of hard wood, saturated with resin, which were spiked down to the ties at intervals of 6 or 8 feet; upon this ran the phosphor-bronze contact-wheels.

The generators consisted of two of Mr. Daft's old type No. 8 series machines, which were operated about 100 yards from the track by a 25 h. p. Buckeye engine situated in the Saratoga Rubber Works.

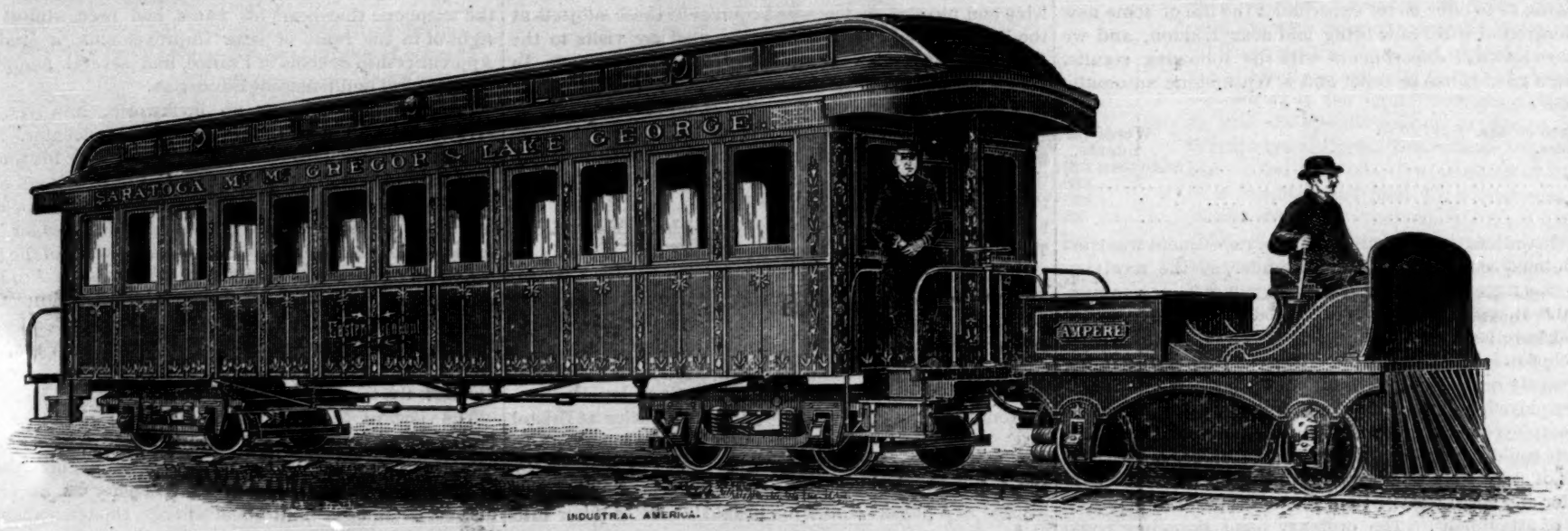
The calculated resistance of the line was about 2 ohms. The actual resistance could not be measured, owing to the continual earth disturbances. By other tests, however, it was evidently very low. The resistance of insulation between central and outside rails, when the ground was wet from a recent rain, reached about 130 ohms, showing a leakage, from that source, of about 1½ per cent. of current with motor under maximum load. The resistance of motor, as given below, is taken while at rest; it is of course higher with the motor in motion, as will be readily understood.

The following are some of the results of the tests made at that time:

Internal resistance of primary machines in parallel	0.42 ohms.
Resistance of motor, from	1.04 to 5 "
" " line (calculated)	0.2 "
" " track insulation	130 "
" " motor arranged for low speed and great traction at start—at rest	3 10 "
Resistance of motor arranged for highest duty	1.15 "
Mean E. M. F. over high resistance shunt at start	100 volts.
E. M. F., with lowest external resis. employed	130 "
Current, when ascending grade	80 ampères.
Revolutions per minute	1050

The actual performance of the "Ampère" consisted in towing an ordinary railway car weighing 10 tons, containing 68 persons in addition to the motor, which weighed 2 tons and had 5 persons upon it. The speed obtained was 8 miles per hour upon a track having a gradient of 93 feet to the mile and included a curve of about 20°. This showed a maximum duty of about 12 horse-power, and, although the actual efficiency was not determined, it ought to be mentioned that the 25-horse-power engine, which actuated the primary machines, was also doing other duty in the factory.

There are several railways now running, operated on the Daft system, and that at Coney Island was the first commercial electric railway in this country. During the last season this road carried 38,000 passengers while that in Boston at the late Mechanics' Institute Fair carried between 4000 and 5000 per week. The New Orleans Exhibition, now being held, also has a railway on the same system, which will be in working order shortly and will connect the various buildings on the grounds with one another. It will also interest our readers to know that the great Brooklyn Bridge will soon have an electric railway in operation upon it, the Daft Co. having received permission to introduce their system there. They are now busily engaged in preparation and several large motors are under way which will embody some new and valuable features that we hope to be able to present to our readers at an early date.



THE DAFT ELECTRO-MOTOR "AMPERE" HAULING AND PASSENGER CAR.

We give in Figs. 2 and 3 a plan and elevation of the locomotive, which is about 10 feet in length and rests upon four wheels. The motor is situated at the rear end of the platform and is incased in a box to prevent injury from dust.

The armature of the motor has a peculiar construction in order to deliver the large current required. Mr. Daft achieves this by grouping equidistant along the periphery of his annular revolving armature as many superposed bobbins as the case in point demands, and fagoting their terminals before leading them to the segments of the commutator to which they respectively belong. Each one of a group of bobbins, on the armature, crosses the magnetic field at approximately the same instant and the current developed in them collectively is of a potential due to their few convolutions and of a quantity proportional to the enlarged channels of escape.

At each end of the armature shaft there is keyed a pulley, from which belts run to the large central pulleys mounted on the counter-shaft, which is situated midway between the driving wheels. Another set of belts connects the latter with the counter-shaft, and the reduction of speed from the armature pulleys to the drivers is in the ratio of 8 to 1.

The two small wheels shown as resting on the rail, are phosphor-bronze contact-wheels; they bear upon the central rail and through them the current is taken up. They are fixed upon springs so arranged that they can mount any small obstacle on the rail; but, being two in number, one of them is always in contact, thus insuring an uninterrupted current.

The driver of the locomotive is provided with a seat, and situated directly in front of him are three switch-boxes. The one toward the right is the main switch by which the current can be turned on or off. The regulation of speed in the "Ampère" is effected entirely by means of the "Multiseries Switch," constituting the middle box, which is so arranged as to effect an almost endless variety of changes in the intensity of the field of force, without the use of idle resistance. In order to accomplish this, some

English Experts on Underground Wires.

Sir Wm. Thomson and Prof. Fleeming Jenkin, under their firm name of Thomson & Jenkin, have furnished Mr. J. W. Mackay with the following report on underground wires:

"In the report which we now have the honor to submit on the employment of underground wires for telegraphic communication we have made no attempt to treat the subject exhaustively. We believe that your object was to obtain our opinion on two broad questions—whether a telegraphic system could be worked rapidly and efficiently through underground lines, and whether these lines would be durable. Messrs. Siemens recommend an underground cable similar to that which is used by the German government. This cable contains seven copper strands, each weighing ninety pounds per mile, and insulated with gutta-percha weighing seventy-six pounds per mile. The seven insulated wires are contained in a sheath of twenty-four galvanized iron wires, each 0.102 inch diameter. The weight of the iron is about 4,080 pounds per mile. These iron wires are further protected by jute and compound. The weight of the whole cable is about 6,100 pounds per mile. Its breaking strength is 4½ tons. This type of cable is well suited for the purpose to which it is applied.

"Experience has shown that cables of this description buried in the ground without further protection are extremely durable, and are exposed to very few accidental injuries. We are unable to fix a term to the life of these cables, because up to the present time no similar cable has, we believe, required renewal or shown any sign of serious injury. These remarks apply both to the iron sheathing and the gutta-percha core. No insects have, as far as we know, attacked the gutta-percha in these or similar cables, either in this country or in any other. The experience in temperate climes has been large, and some very considerable lengths have been employed by the German government to form a network of lines for military purposes. In hot countries some experience has been derived from short lengths of cable used in trenches on land to connect submarine lines with land stations. In some cases extreme heat has injured these short connecting lines, but we believe that this has occurred only where proper trenches could not be dug for their protection. We are, therefore, of opinion that, as regards durability and freedom from accidental interruption, underground cables would give very satisfactory results.

"The transmission of messages through underground wires is subject to two actions which tend to limit the number of signals which can pass from station to station in a given time. The name induction is commonly applied to both these actions, which may be distinguished one from the other as static induction between the copper conductors and the earth and magnetic induction between adjacent insulated wires. We believe that in all cases likely to arise in practice magnetic induction may be neglected, and, moreover, its effects can in some degree be neutralized by judicious arrangements. The effects of static induction cannot be estimated by any known contrivance. The well-known limitation of speed through submarine cables is due to static induction and a similar action takes place in all underground wires. Formulæ derived from submarine lines enable us to calculate with con-

siderable accuracy what traffic can be passed through long underground lines of a given type when these are worked with the same expensive instruments as are employed for submarine lines. Thus, with the type of cable described above, we reckon that by using the siphon recorder, or mirror instruments, a good clerk would work at his full speed sending from twenty to thirty words per minute through any length not exceeding 1,000 miles. A high class of clerks would, however, require to be employed, and it is possible that magnetic induction from wire to wire would in these great lengths be inconvenient. We do not believe that transmission by underground lines in this manner would be likely to compete on favorable terms with transmission by overhead wires. It has therefore been our

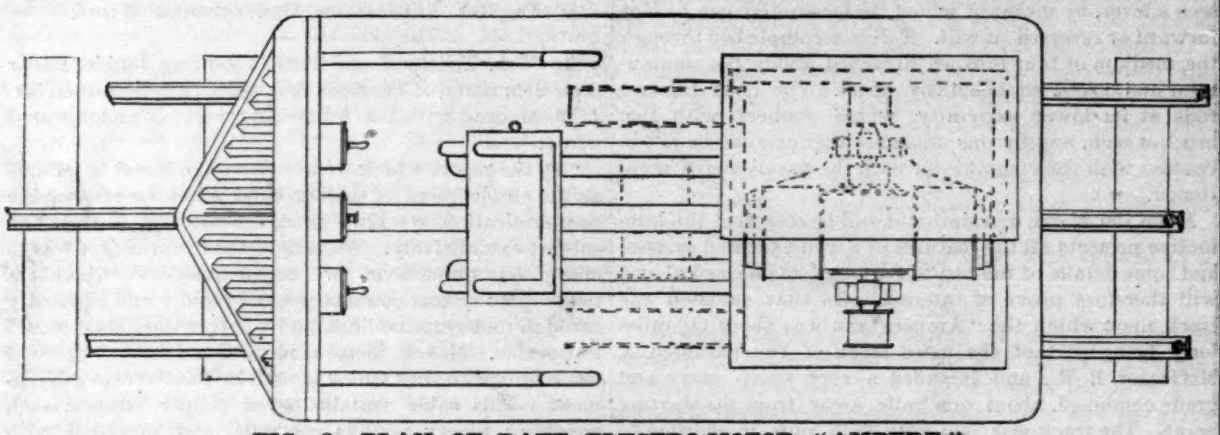


FIG. 2.—PLAN OF DAFT ELECTRO-MOTOR "AMPERE."

duty to satisfy ourselves as to the traffic which could be carried on by ordinary apparatus through the underground lines. The officials of the English post office informed us that they were without any knowledge on the subject, but Mr. Preece, the engineer in chief, was, however, so obliging as to offer us for experiment the use of some new underground wires now being laid near London, and we made a series of experiments with the following results, using a good Morse recorder and a Wheatstone automatic sender:

Length of line. Miles.	Words per minute.
27	more than 220
88	130
116	100
181	35

"On the length of 181 miles a similar experiment was tried with hand sending and a Morse sounder, as the receiving instrument worked by a relay; thirty words per minute were sent, and probably the full speed of thirty-five words could have been reached by a good clerk. The general conclusion is that for short lengths, such as thirty miles, extremely rapid sending by automatic instruments might be employed, and duplexing or even quadruplexing, might be employed. On lines of 100 miles, automatic instruments could still be employed with advantage, but the effects of static induction would be quite sensible and would render any speed greater than 130 words per minute difficult of attainment. The ordinary hand signalling could be practiced with no sensible impediment on all lines under 200 miles in length, and at this distance relays could be worked retransmitting the messages automatically, so as to connect places distant from each other by, at least, 500 miles. There is no doubt whatever that any amount of traffic could be worked through a system of underground wires at the usual rates of hand sending.

"The expense of establishing underground cables must always be greatly in excess of the cost of aerial lines capable of transmitting the same amount of traffic. But in cost of maintenance we believe that an underground system would compare very favorably with aerial lines. Underground wires will also be almost wholly free from interruptions due to storms or to extremes of heat and cold, whereas aerial lines, however well constructed, must always be subject to injury from wind, snow and extreme cold.

"We have heared it suggested that lines composed partly of underground wires and partly of suspended wires would be more difficult to work than lines constructed wholly on the one or the other system. This is an error. It is, however, perfectly in accordance with the theory that the addition of any considerable length of aerial wire to a long underground circuit will materially reduce the speed of working. The reduction in the speed will, however, be less then if the length of line added were also composed of underground wires. Thus, in the experiments already spoken of, an addition of fifty miles of aerial line to the 181 miles of underground line reduced the speed from thirty-five to twenty-eight words per minute. But if an additional length of fifty miles of underground wire had been added the speed would have fallen to fifteen words."

In Vienna.—June 30, 1884, the Vienna telephone lines showed a length of 108 miles; total length of wire in the cables, 807 miles; underground lines of silicon bronze wire 1 mm. in diameter, 1,045 miles. Total subscribers, 708; direct connections, 120. In the month of June nearly 52,500 messages were sent by the subscribers, making 1,750 a day. The two central offices, which open at 7 o'clock in summer and 8 o'clock in winter, closing at 9 o'clock, are served by 42 girls.

Prof. S. P. Thompson.

We extract from the London *Electrician* a few notes from a biographical sketch of this well-known scientist:

Silvanus Phillips Thompson was born at York, in 1851, of an old Quaker family. The Thompsons of Westmoreland and Cumberland trace back many generations, and they number, among various collateral branches, the family of the present Archbishop of York (who, however, dropped the "p" out of his name). The subject of this notice was educated at the Friends' School, York, an institution which has done much for pioneering scientific education. It boasts of the oldest school natural science society in existence. He subsequently studied at the Founders' College, and in 1869 graduated B.A. of London University. Having, however, a preference for science rather than literature, he studied to qualify himself for the post of science-master in his former school at York. This post he abandoned for the sake of further study of chemistry and physics, and pursued courses in these subjects at the Royal School of Mines, supplemented by visits to the University of Heidelberg and other foreign institutions. In 1875 he graduated as Bachelor of Science of the University of London, being bracketed first in Honors, and in 1878 he took the further degree of Doctor of Science, selecting experimental physics as his subject for examination. Meantime he had been lecturing as Lecturer in Physics in the then newly established University College at Bristol, and had also begun to lecture under the Gilchrist Educational Trust. In 1878 he was appointed to the Professorship of Experimental Physics in the Bristol University College, a post which he still holds. In connection with this chair he has, in addition to usual academical courses of lectures, delivered courses upon the technical applications of electricity upon sound in relation to music, and a special course of technical physics for engineers and builders.

From the time that he entered on his duties at Bristol Professor Thompson has made important contributions to contemporary science. The reports of the Physical Society of London and of the British Association bear witness to his zeal as a physicist and his insight as an inquirer into

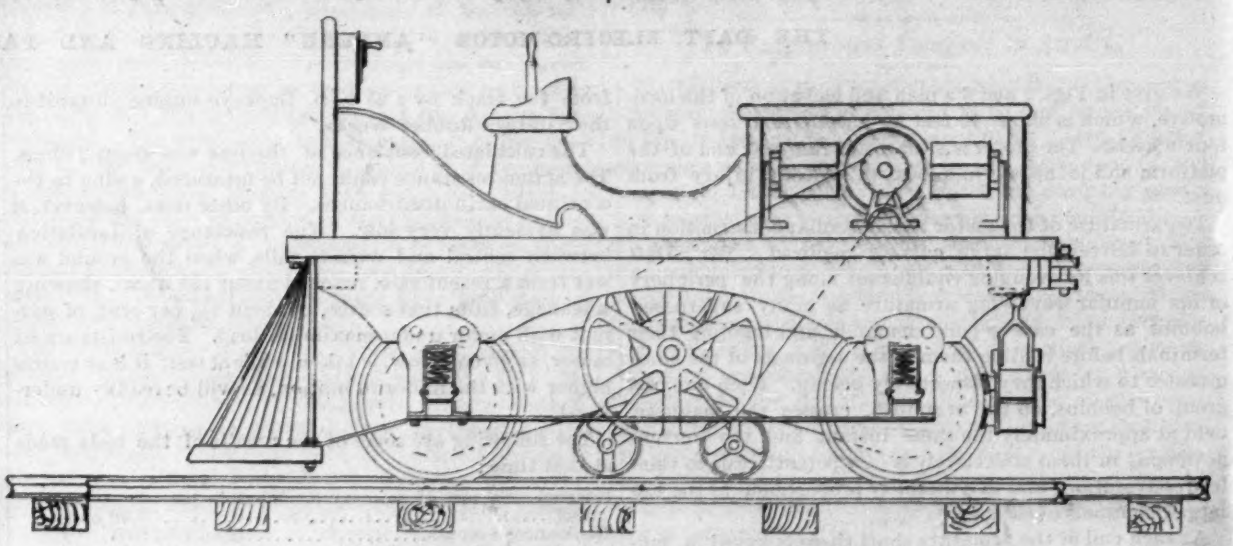


FIG. 3.—ELEVATION OF "AMPERE."

physical, and chiefly electrical, phenomena. His investigations range from the chromatic aberration of the eye to the form of coils in the tangent galvanometer. He is at home in the problems of binaural audition and in the theory of a magnetic balance. The curious optical illusion known as the "strobic circles" was his discovery, and his application of the magnetic figures formed with iron filings, to the illustration of electro-dynamic relations and to the elucidation of the action of the dynamo-electric machine, are well known. The researches of Antoine Breguet were avowedly based on an earlier result of Professor Thompson's. Professor Thompson also has the honor of having applied Clerk Maxwell's electro-magnetic theory of light to the explanation of the behavior of tourmaline crystals in their action upon polarized light; and he has even constructed electro-optic models of these crystals out of iron wire and glass. In the course of this investigation, which was largely mathematical, as well as physical, he brought out a new proof of the fact—still not quite regarded by some physicists as settled—that the displacements in a wave of light are perpendicular to the so-called plane of polarization.

Professor Thompson is, however, better known by his work amongst the applications of science than in the more recondite fields of abstract physics. His studies upon electrical storage and upon dynamo-electric machines are known to all electricians and have received the recognition of the Society of Arts by the award of two silver medals. His Cantor Lectures on the latter subject, delivered in the autumn of 1883, at once established his reputation of being among the foremost in the special study of the construction, theory and mode of working of dynamo-electric machines. The lectures then read before the Society of Arts formed the first really practical effort that had been made to examine this subject with anything like clearness and a thorough grasp. They proved such a useful addition to the current literature of the subject that the reprints issued by the Society and by the publishers were speedily exhausted. They were translated into French, and in part into German. This demand induced Professor Thompson to undertake the much more extended treatise on the subject recently published by Messrs. Spon, and of which a second English and a French edition are already announced. According to the critics, this work is conspicuous not only for the logical completeness of its method, and for the practical nature of its teaching, but for the thorough impartiality maintained by the author in questions of priority of invention. Almost equally remarkable has been the success of Professor Thompson's "Elementary Lessons in Electricity and Magnetism," a work which, to judge by its extensive and world-wide use, is worthy of its place beside Roscoe's "Chemistry" and Huxley's "Physiology" in the well-known series issued by Messrs. Macmillan. Professor Thompson has published several other works, including a biographical notice of Philipp Reis, whose invention in the years 1860 to 1863 of the telephone that bears his name had been almost lost sight of in the fame of later improvements, a study of Apprenticeship Schools in France, and several pamphlets on Technical and Scientific Education.

Professor Thompson is no bookworm, however. A vivacious and fluent lecturer and eager debater, he is equally ready with his pencil as with his pen or his tongue. It is an open secret that he is often the draughtsman of his own diagrams; and he is known to his friends as an amateur artist, with a keen eye for color. His water-color landscapes have been seen and admired on the walls of the Dudley Gallery and in the exhibitions of the Local Academy of Bristol. He possesses a library of electrical literature believed to be second only amongst private collections to that of Mr. Latimer Clark. Original works of Volta, Galvani, Franklin, and even of Gilbertus, may be found amongst the treasures thus collected.

The views of the younger generation of electricians are perhaps not inaptly typified by those of Professor Thompson. He is a thorough believer in the electro-magnetic theory of light, and in the existence of electricity as an entity distinct from both matter and energy, though capable of being associated with the one, as also of serving as the vehicle of the other. In the dispute as to the origin and seat of electromotive force in the voltaic cell he holds firmly to the "fuel" theory—that is to say, that where the energy of the zinc, the fuel of the current, is being given out, there is the seat of the electromotive force. He spoke vigorously in the late debate at Montreal in support of this view, and exposed the fallacy introduced by Sir W. Thomson in limiting the definition of the potential of a body to the potential at some adjacent point in the external air. He regards the dynamo machine as the central focus of electrical progress, and its relation to the science of electricity as the exact counterpart of the relation of the steam engine to the science of heat. His investigations and teaching in respect to this special subject have already borne practical fruit in various directions. Not a few of the latest forms of dynamo-electric machines may be said, without exaggeration, to bear in some point or other the impress of Professor Thompson's labors.

The Excelsior Electro-Plating Dynamos.

BY EDWARD P. THOMPSON, M. E.

Five types of Hochhausen machines are manufactured by the Excelsior Electric Company for electro-plating, namely, Nos. II., III., IV., V. and VII. No. II. is the smallest, and is intended especially for the purpose of electro-plating nickel, which is the most electro-positive of the metals generally deposited in the industrial arts.

For this reason the electromotive force of this machine is higher in proportion than that of the others.

No. III. is used mostly for depositing silver or copper from their solutions. No. IV. (see cut) is chiefly used by electrotypers.

A description of this form will suffice for that of the other sizes of machines, as they are essentially of the same type. The base plate is seen to support a cast-iron frame and an upright bearing for one end of the armature shaft, the other end of the shaft being supported by the cast-iron frame. To the upper and lower part of the frame are bolted two electro-magnets for the field, and between these turns the armature, whose commutator communicates the current to the brushes, which are unusually large, and which are each connected to two semi-circular rings connected to each other by an insulating substance, and capable of being rotated by a long projecting handle for the purpose of adjusting the position of the brushes upon the commutator.

The brushes consist of numerous sheets of copper lying upon one another and held in a rectangular support by means of thumb-screws, so that the brushes may be taken out when necessary for cleaning.

The large cast-iron frame serves not only for supporting the field magnets, but for connecting two of the poles of these magnets, for protecting the armature wires from being scraped while handling, and for offering a channel between the armature and the frame for the circulation of air produced by the rapid rotation of the armature.

Nos. V. and VII. are employed in the reduction of copper from its ores and in the refining of copper.

No. V. has an electrical capacity of 15,000 volt-ampères.

No. VII. has a capacity of 50,000 volt-ampères, with a revolution of 600 turns per minute, the electromotive force being 20 volts and the current being equal to 2,500 ampères; the total weight of the dynamo is 4 tons; it stands 4½ ft. high by 3 ft. broad and 5 ft. long; the armature weighs 1,300 lbs., the resistance being .0001 of an ohm; and it deposits 100 lbs. of copper per hour.

All these dynamos are in general appearance alike, but as the construction of the large dynamo is of the most interesting nature, it will alone be described. The armature is made up of thin iron annular discs, separated by an insulating substance and held at right angles to the shaft by making notches on the inner circle of the annular disc, and sliding them one after the other upon sheets of brass radiating from a long hub fixed upon the axle.

These plates, as in the Siemens armature, are for the purpose of preventing, to a great extent, the Foucault currents. Placed side by side in the above-named manner, they form a cylindrical inner and outer surface, upon which are wound, from the inner to the outer surface, several strands or cable of such a size of wire as may be bent conveniently by hand. This cable, being thus made up of several strands of No. 8 wire, is apparently of very low resistance, and herein consists a difference between the electric light dynamos and those for the electro-deposition of metals. The cable is in some of the machines substituted by copper bars, U-shaped, and fastened to radial arms of the commutator in rectangular slots by means of a tight fit and the application of solder. Bars have heretofore been used by others in the place of wire for armatures of large dynamos, but they have invariably been connected up to wires or bands from the commutator, by means of screws making contact. These contacts being of very small surface, and free to the effects of oxidation, and consequently of high resistance, led to a general dislike to the adoption of bars; but in the present machine the soldering of the contact surfaces, which are several square inches in area, lessens the resistance at the joints to the minimum. There is another objection which has been proposed to the use of bars, and that is their high resistance compared with a bundle of small wires whose total cross-sectional metallic area is equal to the cross-sectional area of the bar. This objection cannot be overcome even by the use of the most superior cast or drawn copper bars.

To prevent the bars or cables, as the case may be, from bending outward by centrifugal force, they are wound about transversely with bands of any suitable cord.

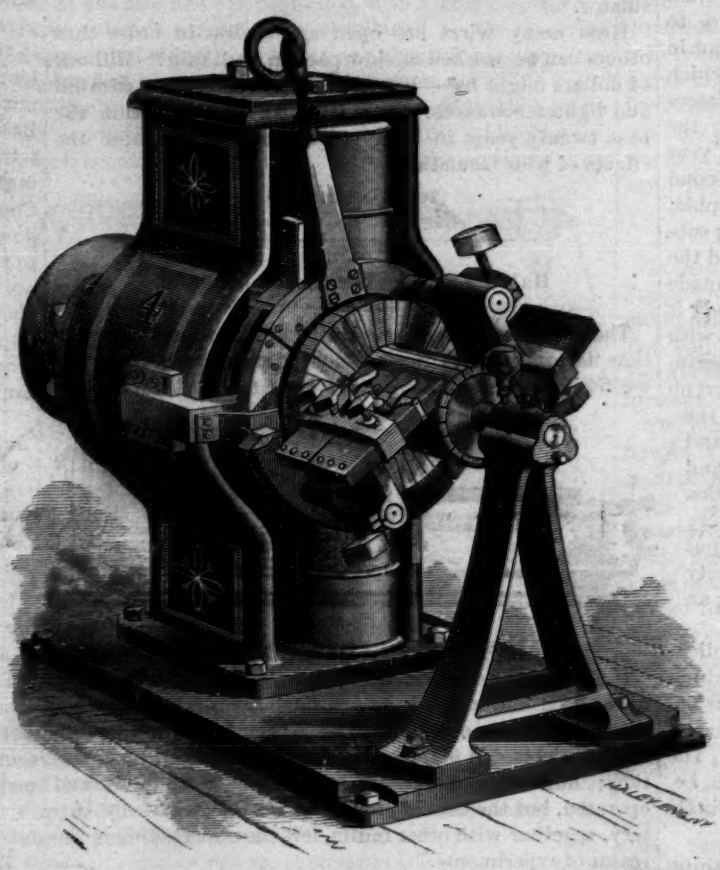
In electro-depositing metals, the counter electromotive of the cells is not much less than the electromotive force of the dynamo, and, further, the cells act for a moment or so, at least, as a secondary battery, so that if the dynamo slows up or if it is starting to rotate, its electromotive force is likely to become, and often does, less than that of the cells. When this happens, ordinary direct-wound machines are reversed as to their poles, and the metal deposited thereafter begins to be redeposited upon the anode; or, in case it were used for obtaining hydrogen and oxygen electrolytically, the change of poles would cause a mixture of the two gases which, when used for any purpose, such as for the calcium light, would be at the risk of exploding with such violence as to be dangerous to surrounding objects. To avoid such mishaps, which have actually happened, electro-plating dynamos are wound in such a manner that the coils of the field magnets are a shunt to those of the armature; so that when a current flows in an opposite direction to that generated by the dynamo, it is not of the same strength in the coils of the field magnets by any means as that in the coils of the armature, and is not of sufficient quantity to reverse the poles of the cores of the poles of the field magnets.

The other details of the machine as well as its general appearance, are substantially the same as in the ordinary Hochhausen electric light dynamo.

The uses to which it may be put are, for reducing metals directly from their ores, to refine metals from their base bullion, to electro-plate articles of commerce, and to produce electrotypes.

Formerly, primary batteries were used for these purposes; but they have many objections and are gradually giving place to the dynamo.

Primary batteries are costly on account of the consumption of zinc or conversion of it into the sulphate or other salt, which has practically no commercial value, and the price of recovering the zinc is greater than the ordinary cost of zinc as obtained from other sources. They need constant alteration in their management. The chemical electrolyte, of whatever nature, changes in its chemical composition and strength, and so must be replenished and frequently thrown entirely away and pure electrolyte substituted. The plates or electrodes must be removed and cleansed, and occasionally substituted by new ones.



THE EXCELSIOR ELECTRO-PLATING DYNAMO.

Their efficiency in electromotive force is high only when first connected up; thereafter it falls rapidly to a constant which is not very high, and so new cells need to be added to supply the deficiency.

The expense of labor, even in establishments for electro-plating small articles, is very considerable, simply in looking after the primary cells.

The Hochhausen dynamo has shown its success above all primary batteries for electro-deposition, and competes favorably with the other forms of electro-plating dynamos. For two years it has reduced from copper cast from the furnace in smelting works large masses of chemically pure sheet copper, which has been largely sold with fair profit at only one cent more per pound than the ordinary impure copper of commerce. More recently a second establishment has been founded where the Hochhausen machine is employed, and where the details of the steps of the process are kept secret in order that others, after hearing of the large profits made from selling electrolytic copper, may not destroy the monopoly by following in the newly-made footsteps. The pure copper is so highly valued that up to the present day of dullness in the metal industry its sale has been increasing at a rapid rate, and it could easily have been sold as cheaply as ordinary copper, and yet with much profit.

These two establishments, together with one using the Keith process of desilverizing sulphur ores, and worked at Rome, N. Y., with the Edison electro-plating dynamo, are the only ones in America. In Europe, however, electro-metallurgy in the refining of metal, and especially of copper, has been practiced with wonderful success, and the pure copper is sold for many departments of industry, but principally for electrical purposes. One of the reasons why it has not earlier been common to carry on this process in America is that manufacturers and purchasers have not heretofore recognized the importance of employing pure copper wire for electro-magnets and for ocean cables.

An inspection of ordinary wire shows splinters protruding through the insulation. Further inspection by breaking the wire at various points disclose holes or oxidized poorer metals, or poorer metals not alloyed with the copper. All these defects increase the resistance at that point, so that the insulation is in danger of burning off and allowing a short circuit, or else the protruding splinter itself will cause a short circuit.

What amateur experimenter ever wound an electro-magnet without immediately unwinding it again on account of a leak? And how often is it necessary to re-wind an armature or the field magnets on account of leaks? Often the short circuit is caused by cuts in the insulation made by careless winding, but it is as often due to the bad effects of protruding splinters, and the reason why a coil leaks after using with its maximum current intended for it is that there are impurities contained in the wire.

To refine copper, a large plate of the cast metal is placed in an electrolyte of cupric sulphate in a vertical position, while opposite is hung an insulated plate covered with graphite to form a conducting surface. The distance between the surfaces is made as little as possible, it being generally about one inch. Several cells made up in this way are put in series and the current passed so as to produce a reguline deposit. The anode is seen to become covered with a dark film of the impurities, consisting mostly of silver, lead, iron and their oxides. Occasionally the plates are raised and this film removed by a brush. A gang of men, two men to every one hundred cells, are kept busy cleaning the plates.

Lifting out the plates and replacing them has a useful effect, second only to that of cleaning them—to wit, that the liquid becomes agitated so as to keep the specific gravity or degree of saturation always uniform. The cathode becomes thicker and thicker to the depth of one-half an inch, when it is removed and used for commercial purposes. The anodes at the commencement are three inches thick, so that several plates of the refined metal are made with only one change of anodes. Again, the use of such thick anodes saves in the amount of metal it is necessary to recast, for at last the anode becomes a mere skeleton, which must be melted up and recast with other metal.

It has been a question, heretofore, from a theoretical standpoint, whether silver is not deposited with the copper, at least in part. Lately, four plates, two by three feet by one-half inch in thickness, were deposited by the Excelsior Electric Company with the Hochhausen machine, and analyzed by a chemist. No silver, not even a trace, was discovered. The solution of cupric sulphate was kept slightly supersaturated, and the current was so adjusted as to deposit reguline. Under these two conditions it is believed to be impossible to deposit silver with the copper.

The film scraped off as described above is saved, and being remelted in a cupel, is so reduced as to yield the silver.

To connect up the dynamo with the cells in series; to cleanse the anodes occasionally, and to prepare the cathodes with graphite, etc., seems not to involve very much engineering experience and skill; but there are necessary, in works for the purpose, many appliances for transporting the heavy copper; for preventing, automatically, the deposit from growing unevenly; for cleaning the copper so as not to lose any of the material in the brush itself; for connecting the cells conveniently and quickly, and for subdividing the current from a large dynamo or from a series of dynamos.

An analysis of the black film shows, on an average, the following composition:

Lead	9.93
Silver	3.89
Copper	41.49
Oxygen and water	16.94
Antimony	5.77
Arsenic	4.96
Sulphur	7.50
Tin	4.00
Iron	1.77
Nickel	1.23
Earthy matter	1.52
Gold	.36
Platinum	.44
Loss	.20
	100.00

The nature of the composition of the residue varies according to the base bullion copper and sulphate of copper which are used; but the above is an average of many analyses.

Notes on Paraffin Insulation.

BY DAVID BROOKS.

In your number of November 29th, in an article headed "Precious Paraffin," and speaking of it as, "A wonderful substance is that snowy, pure, tasteless opalescent wax," etc., etc.

From the "Encyclopædia of Chemistry," published by Lippincott, I quote as follows: "In 1830, Reichenbach obtained from the tar produced when the wood of the red beech was destructively distilled, a white crystalline body to which he gave the name of paraffin, on account of its being difficultly acted on by chemical agents. A year later Dr. Christison, of Edinburgh, obtained the same substance from Rangoon petroleum and named it petroline. From these sources it was obtained in small quantities and with much labor, so that it remained many years merely a chemical curiosity."

As early as 1845, while engaged under Henry O'Reilly, I had a hand in devising an insulator for overhead wires. In 1848 and '49 it took the form of a pressed glass with an iron shield.. A cramp hook was molded into the glass, when the latter was in a molten state, and this insulator was suspended from a cross-arm. We soon found this insulator to be very defective on account of the cracks in the glass. These cracks would absorb moisture which remained in the insulator, and produce an escape of the current, even in clear weather.

About the years 1853-4 we took out these insulators, heated or boiled them in beeswax, drove out the moisture, and filled those crevices with the wax. We used spermaceti, stearine and like substances for that purpose. All our experiments in making an insulator perfect were to detect a current by the tongue—galvanometers were not in use in those days. We had a small hand furnace which the men carried along the line, treated the insulators in this manner. and by that means kept the insulation of the lines in good condition. About the year 1857, while walking past Stevenson's oil store in Second street, between Chestnut and Walnut streets, Philadelphia, I noticed in the window a block of a singular looking substance resembling spermaceti. I went in and asked the name of it, and was told "paraffin," and that it was made from petroleum. I procured a few pounds and applied it to defective insulators in the manner before described with very favorable results. During this time I was superintendent and director of the Atlantic & Ohio Telegraph lines. E. Hall Ogden, now deceased, manufactured the insulators, and I find by his books, as early as 1858 and '59, that he purchased small quantities of paraffin and applied it to the insulators before they left his works. The insulators thus used were for repairs, and no very distinct results could be obtained until 1862, when we put up an entire new set of poles and wires between this city and Pittsburgh, on the opposite side of the road being an additional line of two wires.

After some two years' use of these wires I made application for a patent, and Prof. Page granted a claim, which reads as follows: "The use of paraffin applied to insulators for telegraph wires in the manner described, or in any other manner by which the same result is obtained." The word paraffin was applied to candles as a description, because made of such substances and so treated as to resemble paraffin.

Mackintosh spoke of using it to preserve the sheathing of cables as early as 1835 in an English patent, but in his specifications he states he uses paraffin preferably made from animal matter, evidently showing that real paraffin was not used, except in the sense that a mixture of india rubber and sulphur is called ebonite from its resemblance to ebony.

Anterior to the discovery of mineral oil in large quantities and the products distilled therefrom, paraffin was much too costly a substance to be used for insulating purposes.

The patent granted me, to which I have made reference, was issued Nov. 24, 1864, but was reissued in Aug. 1867. So far these notes are historical on my connection with the use of paraffin.

Its name was given by Reichenbach, its discoverer, from *parum affinis*—little affinity.

In all the German, French and English text books it is spelled without an *e*, the word ending with *n*, and I have always spelled it so myself.

Pure paraffin, instead of being pearly white or opalescent, has an amber color. The pearly white appearance is produced by the use of acids and soda, and that kind does not stand as high as an insulator as paraffin that is purified without the use of those agents. In this respect I have often thought that it resembled glass which is made clear and transparent by the use of metallic oxides—like what is known as "French plate-glass," which is comparatively a poor insulator.

Glass of the highest insulating properties is made of little or no metallic oxides. The most perfect Leyden jar is made from pure sand and kaolin.

When we find it in a solid state we call it "paraffin," when in a liquid state we call it "petroleum" or "refined petroleum." In the solid state the English call it "paraffin wax," and in the liquid state "paraffin oil."

Chemically they are the same, but there are different grades designated by their melting points.

Despite the numberless uses to which paraffin is now applied, its real value is scarcely known. One of its most remarkable properties is its repellence of moisture, and how to take advantage of that principle was an object and study of mine for years, which finally resolved itself into the use of a blown glass bottle inverted and securely protected by an iron shield, and the inner surface of the inverted bottle being coated with paraffin.

An insulator thus made is not affected by rain or moisture.

An ordinary glass insulator in rain will give a deflection of a hundred thousand divisions with an astatic galvanometer, when with the same battery a paraffined bottle insulator will not show one division.

A No. 8 iron wire, insulated with the paraffined bottle insulator, forming a circuit of one hundred and thirty miles, with thirty-five relays of a hundred and fifty ohms each, is worked on the Pennsylvania Railroad, to report the passage of trains, with as much ease in the hardest rain as an ordinary circuit of that length is worked in clear weather. This cannot be done with any other insulation, even if a wire giving a resistance of one ohm per mile were used with that amount of resistance in the form of relays in the circuit.

In the course of four or five years these insulators are taken out and rinsed in paraffin and their insulating properties are restored to their original degree. The cost of this work is far less than the labor and expense of replacing the ordinary broken glass insulators.

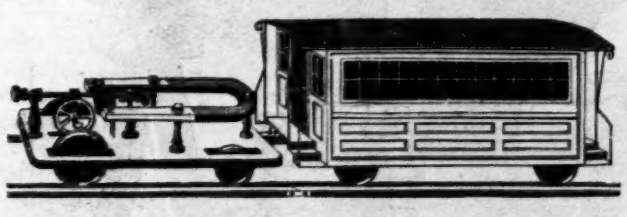
A No. 10 iron wire insulated with the bottle insulator is worth for business three times as much as a No. 4 gauge iron wire in rain insulated with the ordinary insulator.

How many wires are open and useless in order that others can be worked at slow pace in hard rain? Millions of dollars might have been saved, by the use of paraffin and lighter conductors, that have been spent within the past twenty years in heavy conductors, to overcome the effects of poor insulation.

(TO BE CONTINUED.)

Hall's Electric Locomotive of 1850.

The prominence which now attaches to electric locomotion naturally gives rise to inquiry as to its history, and we find, as in most cases, that inventions of importance



HALL'S ELECTRIC LOCOMOTIVE OF 1850.

have been anticipated by earlier investigators, who, through lack of applicability, have been forced to abandon their projects. It is the same story with electric locomotion; numerous models of locomotives were built and operated, but the cost of producing the electricity by battery, together with other faults, left the undertaking in the realm of experiments.

It is interesting, however, to notice the various shapes which these models presented, and to compare them with the types of to-day. In our issue of Dec. 20, of last year, there appeared an article by Prof. Farmer, in which he detailed the various attempts that had been made in electric locomotion, and among them appears that of Mr. Thomas Hall, of Boston, together with a description of his system.

Mr. Hall has been kind enough to send us the original woodcut of the locomotive, which was made nearly thirty-five years ago, and which first appeared in Palmer & Hall's Catalogue of 1850. We reproduce it for the benefit of our readers, and add a few notes in explanation of it, which Mr. Hall has favored us with. The engine which it represented was on the principle of a Page magnet, an electro-magnet revolving between the poles of a permanent magnet. The armature had a worm on its shaft which matched into a gear attached to the driving wheels, the latter being insulated by ivory. The track was laid in 5-foot sections, and was about 40 feet long and 5 inches wide. Under the platform of the car was a pole-changer attached to a lever; when the engine reached the end of the track it ran against an inclined plane which reversed the pole-changer and sent the engine to the other end of the track, where the same thing was repeated: thus the engine was sent automatically from one end to the other. The current, produced by two Grove cells, was conveyed to the engine by the rails.

We have before us, also, a photograph of the "Volta," a finely-constructed model, which was made on the same principle as the former, but so as to resemble very closely a locomotive actuated by steam. Mr. Hall also informs us that, in 1852, he made, for Dr. A. L. Henderson, of Buffalo, a model line of railroad with electric engine, with depots, telegraph line and electric railroad signals, together with a figure operating the signals at each end of the line automatically. This, he states, was the first model of railroad signals or trains worked by telegraph signals.

Blake's New Transmitter.

The transmitter now employed nearly altogether by the American Bell Telephone Company is the Blake, which is based upon the principle of the microphone, and is used because the company has found it to be the best and most reliable under all the varied conditions of use. It is well known to be the invention of Mr. Francis Blake, one of the electricians of the company. Learning that Mr. Blake had made a new transmitter having a wonderful range of reproductive ability, an enterprising interviewer one day last week went out to his place, in the town of Weston, to inquire somewhat in regard to it. The handsome and spacious residence of Mr. Blake is built upon an eminence, and at the foot of the hill are located his laboratory, workshop, house warming plant, etc. He received the writer cordially, saying he had no objection to his testing the new transmitter, but as to the manner and matter of its construction and the principle upon which it was based he could give no information, as anything of the kind would militate against the allowance of claims for invention which he was perfecting.

"Is your invention based upon a principle different from that involved in the Blake transmitter in use?"

"I can say to you that it is entirely new."

"Is it to supersede the Blake?"

"For ordinary short distance telephony the Blake transmitter is perhaps the better of the two, that is, so far as distinctness of utterance is concerned. But my new transmitter has the quality of delivering the transmitted speech with a more sonorous effect than the other and has a wider range or capacity to reproduce voice effects. It will not give the grating vibrations which are sometimes induced in the other by harsh notes and tones. It is intended for long-distance communications and has been used to transmit speech through our new metallic circuit line between Boston and New York, and promises to make long distance telephoning as easy and practicable as short distance talking has become. But you can hear and judge for yourself. Come into the hall where the telephone is placed and sit down on this chair. In replying to me it is not necessary to speak above the ordinary pitch of voice and you need not rise from the chair, though the transmitter is five feet above the floor. I will now go down to my laboratory and after I get there will ring this bell, when you will take the receiver attached to the box and we will talk, when you can judge for yourself."

In a couple of minutes the bell was rung, and the visitor put the receiving telephone to his ear. He was startled at the loudness of the tones he heard, and the distinctness of the voice.

"Do you hear me plainly?" asked Mr. Blake.

"Yes, very plainly."

"I have now on the line the current of five cells; I will increase it to that of ten cells. To know how you can hear my voice with this increased current, hold the telephone at a distance of from six to twelve inches from your ear."

The telephone was held at a distance of twelve inches away, and the voice of the speaker came so loudly and distinctly that the listener was convinced that, even though somewhat hard of hearing, he could hear the speech and understand what was said at ten times the distance.

"Now I shall reduce the current to one cell. Put the telephone to your ear, and note what I say."

The listener obeyed, when the voice of the speaker came to him louder than it is received in ordinary telephonic communication, and with all the beautiful qualities which distinguished the old Blake transmitter when in its best working condition.

"Now I am speaking in a whisper. Can you hear me plainly?"

"Perfectly—perfectly."

It sounded like very loud whispering, but not more sonorous in proportion to the sounds emitted by the speaker than those reproduced from the natural pitch of voice.

"I will now put on the current of 20 cells. Hold the telephone 18 or 20 inches from you."

This was done, and the voice came loud, strong and resonant, without any jar, grating or rasping, as would probably be the case in an ordinary transmitter not adjusted to so strong a current. Mr. Blake then sang a verse of a song in a high key, which was also perfectly transmitted, showing the great range of the instrument and the fact that it reproduces all sounds perfectly, and without any induced aberrations whatever. After a few more tests, going to prove what had already been shown, Mr. Blake returned to the house.

"Well, are you satisfied with the new transmitter? You are the first person who has tested it outside the electricians of our company."

"I am astonished and delighted with it. I did not believe, from what little experience I have had in telephony, that an instrument with a range and capacity like this new one could be obtained. In varying the strength of the current, did you also vary the adjustment of the transmitter?"

"I did not. There is no adjustment for it beyond what it receives from the maker's hands. Therein it differs from some others. Our company owns the Hunnings telephone, which uses granulated carbon between two plates; this transmitter, which you hold in your hand, as well as the receiver, operates on the principle of varying the resistance of the circuit at one or more points in the

same. It is a good telephone, but one little knock or jar, by packing the carbon, may render it inoperative. If the user knew enough to give it a shake before speaking into it, it would go all right. My new transmitter may be jarred and even thrown on the floor, and, if anything, be benefited by such usage."

A Chronological Record of Expiring Electric Motor Patents.

BY F. B. BROCK, WASHINGTON, D. C.

The first electric motor patented in this country was con-

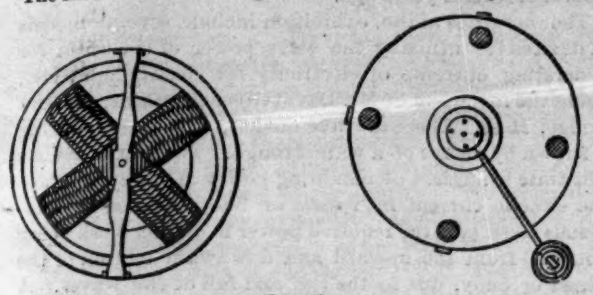


FIG. 1.

structed as early as 1837, and was the invention of Thomas Davenport, of Brandon, Vt.

Davenport styled his invention an "Application of Magnetism and Electro-Magnetism to Propelling Machinery." The frame of the machine is made of a circular ring and disc, horizontally arranged, the former being supported upon the latter by vertical posts. Upon the lower disc are mounted two copper segments, arranged in the centre, as seen in the sectional view, which, together, constitute a circular ring pole-changer.

The electro-magnets are four in number and project horizontally in radial lines from a common centre (Fig. 1). Through this centre passes a vertical shaft having bearings in the frames so as to have a revolving motion. The conducting wires from the source of energy extend up from the copper segments parallel with the shaft to the electro-magnet.

Davenport arranges within the inner periphery of the upper horizontal ring a ring of steel cut in two, forming a pair of steel segments, which he terms artificial magnets. The description of this device is somewhat obscure, but the inference is that these are permanent magnets, and being semi-circular in shape, they approximate the form of a horseshoe.

The principle of operation of this machine will be apparent to the electrician. The polarity of the electro-magnets is changed during their revolution by the wiping contact of their connections with the two segmental plates on the bottom disc, these segments connecting with the north and south poles of the battery.

As a remarkable instance of the granting of a broad claim by the Patent Office to an inventor, that of Davenport may be cited. It reads: "Applying magnetic and electro-magnetic power as a moving principle for machinery in the manner above described, or in any other substantially the same principle."

June 27, 1838, Nelson Walkly, of Tuscaloosa, Ala., devised an electro-motor, the principal improvement being in the mode of changing the poles of the electro-magnets.

The electro-magnets employed by Walkly are semi-circular in form. Two of them are fixed to a horizontally-revolving wheel with proper insulations. The ends of the wires on the revolving magnets are connected with two segmental collars placed on the vertical shaft as shown in the perspective view. These collars are placed, one above

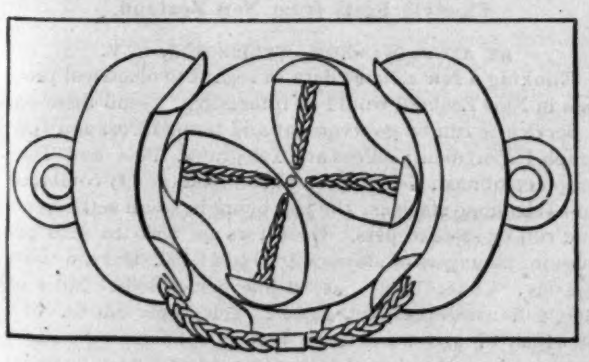


FIG. 2.

the other, on the shaft, but insulated therefrom. The connections of the two revolving magnets terminating in the segmental collars are taken therefrom by wiping electrodes arranged to lie against the collars which lead to the negative and positive elements of the battery (Fig. 2).

Through a post fixed in the right-hand side of the upper platform (see Fig. 3) are fixed two conductors connected with the battery.

The outer ends of these spring conductors, when at rest, press against an insulated pin, and between their ends is interposed a lever, the end of which is just the size of the insulated pin. This lever is composed of two plates of metal with a piece of wood between them, and is made to vibrate by means of a double elliptic cam fixed on the upper end of the vertical shaft by means of a connecting pitman. If more revolving magnets are used than two, the cam may be fixed on a pinion, revolving more times than the main shaft, so as to change the polarity every time one of the rotary magnets comes opposite one of the stationary ones.

To magnetize the outer, or stationary, magnets the current of electricity passes from the positive side of the battery to the conductor, and from thence to the lower plate of the vibrating lever, and so to one of the stationary magnets. When the machine is at rest, the lever will be in contact with the spring conductors, and the ends of the rotary magnets opposite the ends of the stationary ones. By moving the rotary magnets the cam will move the end of the lever and the end of the spring away from the insulated pin, leaving the opposite spring resting against the pin. The north poles of the stationary and rotary magnets will then repel each other, causing the latter to revolve, so that the lever is vibrated back, thereby moving the spring on the opposite side and changing the polarity of the stationary magnets, and so on.

The next expired patent for an electrical motor in chronological order was that granted to Solomon Stimpson, Sept. 12, 1838.

Between two vertical circular brass rings are attached the poles of a series of stationary magnets by screws. Within or between the stationary magnets are a series of revolving ones mounted upon a central shaft, the whole number of magnets—both stationary and revolving—being twelve. The wires of all the stationary electro-magnets are connected terminally with mercury-holding cells resting on the base plate. These insulated cells, the inventor states, are for battery communications.

The electric connections of the revolving magnets pass out at one side and are connected with a pole-changer.

The galvanic current is not distributed to the revolving magnets individualiy, but they are charged by pairs, the magnets of each being charged in sequence.

Wiping springs connected with the conducting wires are arranged to lie against the revolving pole-changer, which is composed of a series of metallic segments with

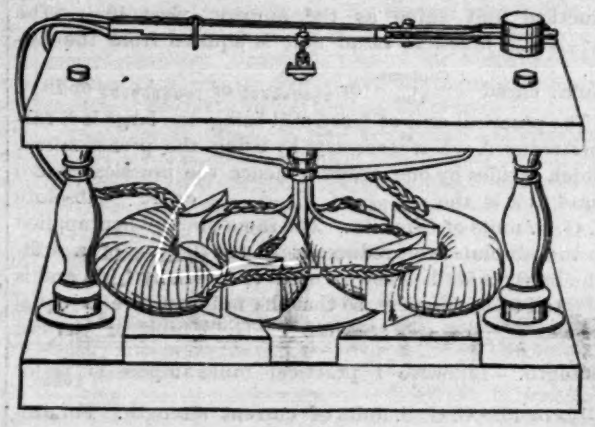


FIG. 3.

interposing insulating material. The wiping contact is made upon the opposite sides of the pole-changer, and thus are constituted two permanent battery poles. As the machine revolves, the two opposite extremities of the wires are presented in alternate order to the same battery pole, and thus a change of magnetic poles is effected. Power is applied through a pinion on the shaft commencing with the cog gear (Figs. 4 and 5).

(TO BE CONTINUED).

The Magnet as a Hypnoscope.

In a lecture to the Midland Institute delivered some months ago, on the Six Gateways of Knowledge, Sir William Thomson pointed to the possibility of a magnetic sense, which might give a sensation of magnetism quite different from the sensations of heat, force, and so on. Soon afterward Professor W. F. Barrett recounted some experiments which came under his notice, and which tended to prove that certain persons were capable of feeling the presence of magnetism as developed by the core of a powerful electro-magnet. Dr. J. Ochorowicz has investigated the subject still further, says *Engineering*, and observed that all persons sensitive to the magnet are hypnotizable in a corresponding degree. In studying the matter he uses an instrument termed a hypnoscope, which is simply a tubular magnet slit up the side, the edges of the slit forming the poles, which are preserved by an oblong armature. Such an apparatus need only be 3 or 4 centimetres in diameter and 5 or 6 centimetres long; weighing 150 to 200 grammes. Made of Alvar steel, it is very strongly magnetic, and will sustain twenty-five times its own weight. It is applied as follows: After the armature is drawn off, the index finger of the person to be tested is thrust into the tube of the hypnoscope in such a way that the latter hangs from the finger by its poles, which are connected through the finger. After two minutes the magnet is drawn off and the finger examined. Dr. Ochorowicz states, of a hundred persons chosen at hazard, and examined in this way, seventy will observe no change, but thirty will experience changes of two sorts, subjective and objective. For example, 20 per cent. declare they feel a pricking sensation as of needles entering the skin, 17 per cent. a cold air or a sensation of heat and dryness. These two sensations may coexist, one being felt in the right arm, and the other in the left. The cold air resembles that felt in front of an electrostatic machine. Some 8 per cent. of the total will probable feel disagreeable sensations, and a smaller number of sensations of swelling, heaviness of the hand, and irresistible attraction. The objective changes are either involuntary movements, insensibility (anesthesia), paralysis, contraction of the muscles. These changes disappear after a few minutes by light friction, but without that will

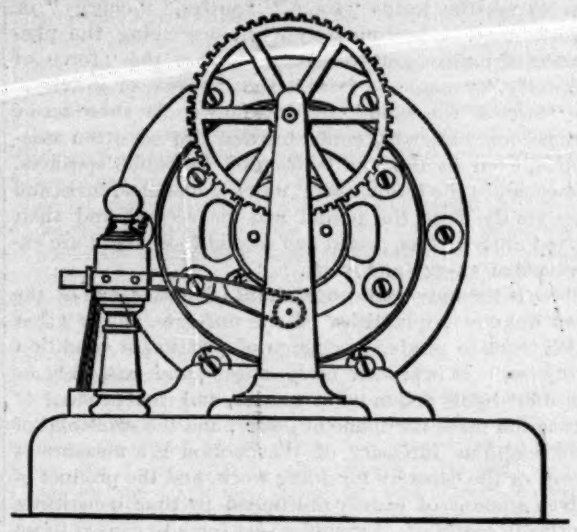


FIG. 4.

last several minutes, or even hours. Subjects of this class can be hypnotized in a single séance. Whether these effects are really magnetic Dr. Ochorowicz considers doubtful. Magnetism, he thinks, does not explain all. It is only the substratum of another action so feeble from a physical point of view that it is not discoverable by our instruments of research. What this other action is, whether a new force or a new manifestation of force, he does not in the present state of our knowledge venture to say.

Blind Telegraph Messages.

In deciding a lawsuit in a Philadelphia court, last week, Judge Thayer gave some valuable advice to the general public with regard to sending and receiving telegrams. The suit was Isaac Nusbaum vs. The Western Union Telegraph Company, to recover damages for an error in a message.

The plaintiff is a dealer in furs, and contracted with Shoyer & Co. to deliver to them a lot of musk-rat skins, an article the price of which is regulated by the London sales. A special sale was to take place in that city on the Tuesday following the day on which the contract was made, and Shoyer & Co., anticipating that there would be a rise of at least 10 per cent. over the previous quotations, agreed to pay the plaintiff 22 cents a piece for the skins. If prices went higher, they were to inform the plaintiff by telegraph. He went to Salisbury, Md., and while there Shoyer & Co. sent him the following telegram:—"Obey instructions given Sunday. Rates 10c. higher. Everything else lower." The message transmitted by the company and received by the plaintiff read:—"Ober instructions given Sunday. Rates 10 higher. Everything else lower." Nusbaum thought the word "ober" meant "over" and interpreted the message to mean that musk-rats skins were 10 cents higher than anticipated. He accordingly bought 2,800 skins, giving 2 cents a skin more than otherwise would have been paid, and lost $560 by the transaction. On the trial of the suit brought against the company, he offered to prove these facts, but the court rejected the offer, and entered a non-suit. In refusing the

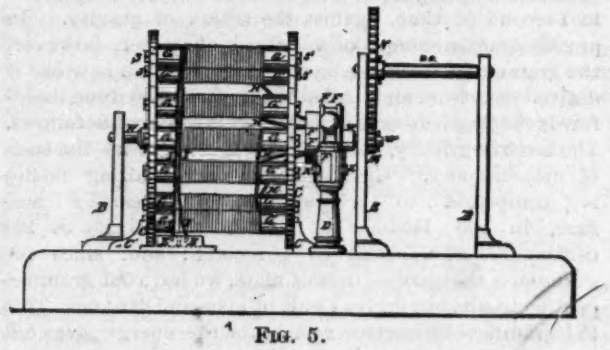


FIG. 5.

motion to take off this non-suit, Judge Thayer says:—"We think the offer was rightly refused."

"The message, as received by the plaintiff, was an insensible message. He had no right to guess that the insensible word 'ober' meant 'over,' and then to interpret the message as meaning that muskrat skins had advanced 10 per cent. beyond the anticipated price on which his contract was based. When he received an insensible message it was his duty to have telegraphed back for the correct message or to ask his correspondent the meaning of it. There was no offer to show that he had done this. He was himself guilty of negligence in assuming to act upon an interpretation of the message which was totally unwarranted by the terms on which it was sent. It was certainly as easy to guess that 'ober' meant 'obey' as to guess that it meant 'over.' He took the risk of his own false interpretation, and cannot hold the company responsible for his own negligence."

A Chat About Units and Their Meaning.

BY L. R. CURTISS.

Amid all this clamor about new electrical and mechanical units, before the nomenclature of the subject becomes too unwieldy, it might be wise to review those we already have and see where they apply and misapply. It is common to see the terms "force," "power," "energy" or "work" used indiscriminately when describing the phenomena of nature, and we so often hear of the "force of electricity," "magnetic force," the "power of gravity," the "force of the wind," that it is no wonder these terms have become somewhat confusing and are so often misapplied, even in the text books used by public speakers. In mechanics the fundamental units of distance, mass and time, are the foot, the pound and the second, and their derived units of foot-pound and second-foot-pound are expressions of energy and work.

Force is the universal concomitant of matter, one of the great unknown quantities of the universe, and is "that which tends to produce a change of position or condition of matter." It is known by its effects, and can only be measured by its action upon matter, and the product of that action takes the name of *power*, and the sum-total of the strength or intensity of that action is a measure of *energy*, or the capacity for doing work, and the product of a given amount of energy multiplied by time constitutes the *rate of working*. Examples: let force be caused to act against gravity and raise, from off its support, one pound; this is *power*. Let power be expended sufficiently to raise one pound one foot high; this is *energy*: the foot-pound. Let energy be expended for one second in raising one pound one foot high; this is *rate of working*: the second-foot-pound. Hence, to recapitulate:

Force is primeval and universal.

Force acting upon mass reveals *power*.

Power multiplied by distance is a measure of *energy*, and implies capacity for work.

Energy multiplied by time constitutes the *rate of working*.

If force be brought to bear in raising a one-pound clock-weight to an indefinite height, the fact is apparent that *power* has been expended, but we have no conception of the energy stored up or its capacity for work, simply because distance is not included, whereas the energy stored up in a mass of one pound raised *one foot does* convey the idea that in running down it is competent to perform one foot-pound of work, and, if the time is stated, say one second, we have an example of *rate of working*, the second-foot-pound.

The forms of energy are two, potential and kinetic. The potential is due to position or condition, while the kinetic pertains to motion, and both alike imply an inherent capacity for overcoming resistance or doing work. In the example of a clock weight wound up, it possesses potential energy due to its position raised against gravity, whereas in running down it takes or assumes the kinetic form. The two forms of energy may be divided into the molar and molecular. Molar, when it pertains to mass as in the falling of weight or relaxing of springs, and molecular in the various manifestations of energy due to heat, light, electricity and magnetism.

In mechanical measurements the foot, the pound and the second are largely used, whereas, for electricity, the metric system prevails the world over, so that for the unit of distance, mass, and time, we have the centimetre, the gramme, and the second as the fundamental electrical units.

These are known as the C. G. S. (centimetre, gramme, second) units, and refer to the electrical energy expended in raising, to the height of 1 centimeter, 1 gramme in 1 second of time, against the action of gravity. In practical measurements of a refined character, however, the gramme is found to be too large; hence a new one is derived therefrom and called the *dyne*. The dyne therefore is the *practical* unit of mass, and is acquired as follows. The force of gravity, being constant, is taken as the basis of measurement. Gravity acting upon falling bodies is competent to produce at the earth's surface, in the latitude of Paris, a velocity of 981 centimetres at the end of 1 second; and, since the gramme is the *absolute* unit of mass, we have 981 gramme-centimetres as our derived unit of mass and distance. This 981 gramme-centimetres represents the energy given out by 1 gramme in falling 981 centimetres, or its equivalent of 981 grammes in falling 1 centimetre. And since velocity of mass, as influenced by gravity, is irrespective of the amount of matter acted upon, it permits us to reduce the unwieldy number of 981 to unity, which, being done, gives us the *dyne*. Hence this practical unit dyne is the $\frac{1}{981}$ part of a gramme. Likewise the dyne-centimetre is the practical unit of energy, and the dyne-centimetre-second is the practical unit for rate of working. This unit dyne, when applied to work, however, is called, for brevity's sake, the *erg*. The practical unit erg always implies the use of time, and refers to the rate of working, and is synonomous with "dyne-centimetre-second," being analogous to, and a very small fraction of, the "horse-power-second," as used in mechanics.

The *absolute* electrical units with their derivatives and symbols are:

E for volt; or, the E. M. F. carrying 1 ampère of current against 1 ohm.

C for ampère; or, the current strength when 1 volt encounters resistance of 1 ohm.

R for ohm; or, the resistance when 1 volt carries 1 ampère of current.

And their derivatives and symbols are:

W for watt or volt-ampère, the *energy* consequent upon one ampère multiplied by one volt.

Q for coulomb or ampère-second, the quantity in ampères passing in 1 second.

J for Joule, the volt-ampère-second, or volt-coulomb, the *work* consequent upon 1 ampère multiplied by 1 volt multiplied by 1 second.

K for Farad, a condenser-capacity of 1 coulomb under pressure of 1 volt.

The coulomb differs from the ampère only by the duration of time, and takes the place of the ampère-second. Volt × ampère, or, CE is the volt-ampère or watt and refers to energy expended. Volt × coulomb, or EQ, is the volt-coulomb, and refers to the rate of working, differing from the watt only in the element of time T. Some of the absolute units are frequently found to be too large, as in the previous case of the gramme unit, and others too small to be practical; hence the following *practical* units are derived therefrom:

A *practical* unit volt = 100,000,000 absolute C. G. S. units of E. M. F. or potential.

A *practical* unit ampère = $\frac{1}{10}$ absolute C. G. S. units of current strength.

A *practical* unit ohm = 1,000,000,000 absolute C. G. S. units of resistance.

A *practical* unit coulomb = $\frac{1}{10}$ absolute C. G. S. units of quantity.

A *practical* unit farad = $\frac{1}{1000000000}$ absolute C. G. S. units of capacity.

The $\frac{1}{10}$ practical ampère unit is acquired from the formula: Ampère = $\frac{\text{Volt}}{\text{Ohm}}$ or the practical ampère = $\frac{100000000}{1000000000}$ or $\frac{1}{10}$ or 10^{-1} absolute C. G. S. units of current strength. The coulomb differing from the ampère only by time, and time being unity, our coulomb has the same practical unit value as the ampère, viz.: 10^{-1}. The $\frac{1}{1000000000}$ practical farad unit is aquired from the formula: Farad = $\frac{\text{Coulomb}}{\text{Volt}}$ or $\frac{\frac{1}{10}}{1000000000}$ or $\frac{1}{1000000000}$ or 10^{-9}.

The practical unit of farad still being too large it is further reduced, when necessary, by using the prefix *micro*, which divides by one million, hence the practical *micro* farad unit is the $\frac{1}{1000000}$ of $\frac{1}{1000000000}$ or 10^{-15} absolute C. G. S. units of capacity. The same prefix when applied to the absolute volt reduces it to the $\frac{1}{1000000}$ of a volt. The prefix *mille* is likewise used to divide by 1,000 and is adapted to the ampère, so that the mille-ampère is equal to the $\frac{1}{1000}$ of the absolute C. G. S. unit of current strength. Likewise 1 practical mille-ampère is $\frac{1}{10}$ or $\frac{1}{10000}$ or 10^{-4} C. G. S. units of current strength. For amplifying the absolute units of ohm and joule the prefix *meg* augments a million times, thus 1 meg ohm equals 1,000,000 ohms, and 1 meg joule equals 1,000,000 joules.

The foregoing units, together with their prefixes and derivatives, to say nothing of those which pertain to static electricity and magnetism, not here enumerated, are surely voluminous enough to satisfy the most fastidious, and cause them to cry out against the demands of the unit fiends that threaten to overwhelm us with a never-ending complication of nomenclature. This is the more apparent, when we reflect how easy it might have been to express the various complications of these fundamental and absolute units by six words, volt, ampère, ohm, centimetre, gramme, second, and their derivatives, and at the same time show the relationship between the practical and absolute units by simple arithmetic. One hundred million volts is as easily comprehended as is "one practical unit volt." One-tenth ampère has the same significance as "one practical unit ampère." The "volt-ampère" *is* the watt, likewise "ampère-second" *is* the coulomb; the "volt-ampere-second" *is* the volt-coulomb or vomb, and, whether applied to rate of working or to capacity of condensers, expresses all that is implied by the joule or farad.

Characteristics of Lightning Strokes.

At the first monthly meeting of the session of the Royal Meteorological Society in London, England, Colonel the Hon. Arthur Parnell read a paper on "The Mechanical Characteristics of Lightning Strokes." The main objects of this paper were, first, to attempt to show that lightning is not a sort of electric fluid that descends from the clouds, injures buildings and persons in its course and dissipates itself in the earth, but that it is a luminous manifestation of the explosion caused by two equal forces springing toward each other simultaneously from the earth and the under surface of the inducing cloud and coalescing or flying out nearly midway between the two plates of the electrical condenser formed by the earth and the cloud. Secondly, to demonstrate that of these two forces it is the earth-spring or upward force alone that injures buildings, persons or other objects on the earth's surface, and that constitutes tangibly what is rightly known as a lightning stroke. The author gave the details of 278 instances, the records of which were intended to demonstrate with more or less precision the existence of an upward direction in the force of the stroke.

The American Electrical Exhibition.

Among the new electric companies to exhibit is the Mather Electric Light Company of Hartford, Ct., the engines for which are in place, and Messrs. Hill, Clark & Co. have put in a 7-horse power Otto gas engine to run the Bernstein lamps, and a 25-horse power Payne engine to run Arago lights. Historical telegraph apparatus have also been secured, which were loaned by George W. Adams, Superintendent of the Boston Electric Protector Association. Mr. Adams also sent a carbon with which the 57,000 candle-power Maxim electric light was produced on the Common several years ago.

The novelties at the exhibition include several models of devices for utilizing the wave power of the ocean for generating currents of electricity for electric light, etc., being the invention of Mr. David Greene Haskins, of Cambridge, Mass. There are five models, and their working is shown by means of a water trough. Two of the models illustrate a method of obtaining power at sea to produce the electric current in vessels or buoys located on dangerous reefs, etc., the required power to do this work being obtained from the upward and downward motion of the vessel or buoy, due to the rise and fall of the waves. A perpendicular shaft, pivoted at either extremity, extends downward into the water. Radiating from the lower part of this shaft are horizontal rods, to which are attached, in a corresponding direction, elastic blades or hinged blades, which are limited in their bend or swing to a few degrees above and below the plane of the horizon. Pressure of the water upon either side of these blades causes the shaft to rotate, and always in the same direction. Another is a model of a device designed to be firmly secured to rocks, or to piles driven into the ground, at or near the line of low water. Its mouth, which is considerably larger than its inner end, faces the waves setting in from the sea. By an arrangement of pipes and valves in this tunnel, the water entering by the mouth is suddenly checked in its flow in such a manner as to cause both the direct and reactionary force of the water to impinge simultaneously upon the valve of an air chamber provided with an escape pipe; and, opening the same, to compel a portion of the water to enter said chamber, thereby condensing the air enclosed in it. The water thus brought under the pressure of the condensed air is in turn driven by it through the escape-pipe into an elevated reservoir. This would be a storage of energy, which could easily be converted into electricity. Mr. Haskins also shows an automatic water wheel for utilizing the force of water in motion, either in rivers or estuaries, or on the seacoast. It admits of being set either vertically or horizontally with respect to its axis. The power is derived from the action of the water on the elastic or hinged and limited blades, which connect the peripheries of its sides on lines parallel with its axis. This wheel works well, whether wholly or partially submerged, and responds always in the same direction to the force of the water from whatever quarter it strikes it.

The New York Consolidated Electric Light Company has some 32 lamps outside of the pavilion, and some inside.

The illuminated cottage of the United States Electric Company, with 100 lamps, makes a good showing.

The Bernstein exhibit of 40 lamps is run by an Otto gas engine and dynamo in the basement.

Prof. Dolbear has a historical exhibit of his various telephonic devices, which his assistant explains to visitors in a clear and intelligent manner. The phonograph attracts and amuses crowds every evening. The Bidwell electric railway is still a great attraction. Indeed, it is one of the strong cards of the exhibition.

Electric Facts from New Zealand.

BY ANGUS M'CURDY, WELLINGTON, N. Z.

Thinking a few reliable data in regard to electrical progress in New Zealand would be interesting, I send them on.

Service is run by government and termed Post and Telegraph Department; offices are Telegraph, Post and Telegraph combined, Telegraph and Railroad (gov't) combined and Telephone stations, the last being in small settlements and run by storekeepers. Operators get $500 to $800 per annum, managers of stations $800 to $1,700. Duty, 8 hours per day. Code, British. First line opened 1866. Miles of line, 4,074; miles of wire, 12,668. Telegraph offices, 334, of which 97 are worked by Bell telephone with Blake transmitter. Number of telegrams during past financial year, 1,599,400, exclusive of service messages on business of Telegraph Department. Messages are of four codes—Urgent, Ordinary, Delayed and Press. Urgents are double, delayed are half rates; press are special reduced rates. Ordinary Commercial are: First 10 words 1s., with 1d. for each word extra. Telegraph money orders may be sent at 1s. for the telegram and 4d. [illegible] per £1. Rates are same to all parts of colony. [illegible] with a few embossed [illegible] Cables between North and South Islands [illegible] conductors and one of three conductors. [illegible] are duplexed. All wires are worked on [illegible] for commercial business 8 A. M. and 6 P. M. and 7 P. M. to 8 P. M. Many offices are open [illegible] A. M. and 7 P. M. The principal stations are open all night during "recess," and 2 A. M. during Parliamentary session. Population of whole colony about 500,000, certainly less than 550,000.

The capital, seat of government and central port [illegible]

colony is Wellington. The headquarters of the Post and Telegraph Department are in the Post and Telegraph offices, a magnificent building on Custom-House Quay, built at a cost of over $118,000. It is considered one of the handsomest blocks in the colony. The accommodation for the staff is excellent, and the operating room will compare favorably with any in existence doing same amount of traffic. The fittings, etc., cost a sum not far short of $30,000.

The principal stations are Wellington, Blenheim, Auckland, Dunedin, Christchurch, and Napier. Blenheim and Napier are transmitting stations and do little originating traffic.

Now for telephones. There are seven exchanges in the colony so far. Dunedin, over 300 subscribers; Auckland, over 250; Wellington, over 200; Christchurch, over 150. Smaller exchanges than 100 each are at Invercargill, Nelson and Oamaru. There are about 1200 (all told) subscribers in the colony. Rates per annum $50, payable quarterly in advance. "No pay!" "No telephone!" Government has the monopoly. Bell telephones, Blake transmitters and magneto bells are universally used here. The switch system is one devised by C. Lemon, Ph. D., Superintendent of P. and T. Dept. One operator attends to 200 subscribers. Average number of calls for 200 subscribers is over 200 per hour during commercial hours. Highest number in any one hour 412 calls for 200 subscribers. Exchanges are open day and night throughout the week and for a few hours on Sundays.

The Bank of New Zealand employs an annunciator of about a score of numbers in one of its establishments for the use of its employés only.

Electric fire alarm systems are in operation in Auckland and Christchurch and are to be introduced by the municipal authorities of Dunedin and Wellington.

Now for the electric light. New Zealand-owned steamers on the United Kingdom and the intercolonial trade are fitted with electric light.

The first private residence lighted by electricity is that of Dr. Lemon, the Superintendent of Telegraphs. Lamps, Swan; dynamo, Siemens shunt wound. The Gulcher Co. have installed their system at Port Lyttelton. The principal installations in the colony, however, are Parliamentary buildings with Swan lamps, Siemens shunt wound dynamo; Kaikorai Mills, Swan lamps, Siemens dynamo; government printing office, Edison's old type lamps, Edison's dynamo. There are several others I have not been able to gain details of in time for the mail.

A South Island inventor, Mr. Frank Hebden, claims to have invented an apparatus whereby all raspy and abominable noises are done away with and the slightest whisper audible at some distance from the receiving telephone. An official trial is to be made. I will forward result early.

I have to record my indebtedness to Dr. Lemon, Superintendent, and Mr. Gray, Secretary of the Department, for their courtesy in placing official papers at my disposal in order that these facts might be beyond question.

Hell Gate Light.

To the Editor of The Electrical World:

SIR: In the issue of THE ELECTRICAL WORLD for Dec. 20 there is a cut and brief description of the new electric light at Hell Gate, East River. The article is somewhat erroneous and misleading, as to the methods of the Light-House Establishment in constructing new light stations, and I am authorized to state that this work was performed under the direction of Gen. J. G. Barnard, Engineer of the Third Light-House District, after plans prepared and approved by the U. S. Light-House Board.

The company furnishing the electric apparatus was represented by an agent who assisted in placing the dynamo, conductors and lamps, but had nothing to do with any other part of the work. Neither the engine nor any other part of the machinery was furnished by the Cooper Manufacturing Co.

JOHN MILLIS,
First Lieut of Engrs., U. S. A.

TARRYTOWN, N. Y., Dec. 30, 1884.

Criticising the Critique.

To the Editor of The Electrical World:

SIR: In the otherwise very complimentary review of "Illustrations and Descriptions of Telegraphic Apparatus," in your issue of the 27th inst., objection is made to the title of Plate XIV., viz., "Polar duplex [illegible] one station only," which you regard as "[illegible] duplex than it is a so-called Stearn's duplex [illegible] reality" it is a combination of both these systems."

Now, whatever else the combination may be called, it certainly cannot be said to be such a one as that mentioned in the article referred to, since no important piece of apparatus appertaining to a Stearn's duplex system appears in Plate XIV.

On the other hand, all the principal parts constituting a polar duplex are employed, which therefore seems to justify the use of the original title.

A. C. TERRY.
W. FINN.

BUFFALO, N. Y.

Officers Elected.—On Dec. 28 the Worcester & Nashua Telegraph Company elected the following named officers: Directors, Charles S. Turner, of Worcester; C. L. Swan, of Clinton; C. T. Symmes, of Lancaster; Charles G. Stevens, of Clinton; Lyman Brooks, of Worcester. C. S. Turner was re-elected President and B. T. Hammond Clerk and Treasurer.

THE TELEGRAPH.

Reducing Rates.—Monday, Dec. 29, a reduction of 25 per cent. in the rates to and from Mexico and the United States was ordered by the management of the Mexican Telegraph Company.

An Opponent of "Bucket Shops" Put in Office.—The new President of the Chicago Board of Trade is Mr. E. N. Blake, who has distinguished himself by making a determined fight, as chairman of the committee on quotations, against the use of tickers by the bucket shops.

Telegraphic Conference in Berlin.—On the 10th of August the Berlin Conference of Telegraphers will open. To all the governments of nations that participated in the St. Petersburg Conference invitations will be sent. This meeting will be both interesting and important.

Negroes Stealing Copper Wire.—The Baltimore & Ohio Telegraph Company are having great trouble with their copper wire that runs through Kentucky and Tennessee. As fast as the line is put up the negroes climb the poles and steal the wire—stealing sometimes a mile at a time. The iron wire between Evansville and Nashville has never been tampered with; but from all aspects the copper wire line will have to be abandoned. So writes a Western correspondent.

Lower Rates.—General Manager A. S. Brown, of the Mutual Union Telegraph Company, says that the rates on the lines of that company had been reduced to meet the latest cut of the Baltimore & Ohio people. The Mutual Union lines, it is claimed, cover every point reached by the Baltimore & Ohio wires, with the exception of some of the stations on the Baltimore & Ohio Railroad. Although the Mutual Union lines are part of the Western Union system, being absolutely controlled by the last-named company, the officers of the Western Union Company say that no reduction of rates will be made by that company to meet the Baltimore & Ohio cut.

Cutting Down Expenses.—Reductions by the Western Union Telegraph Company are reported in the clerical force at the main building, No 195 Broadway, whereby the services of a half-dozen clerks are dispensed with by the abolition of their work. The salaries of a large number of clerks in different departments in the building have been reduced. The total amount involved is not large. No changes have been made in the salaries of operators. There is nothing in the shape of a general reduction. Under the plan of the company in cutting off extra work, etc., the general expenses have been reduced at the rate of $50,000 a year in the past six months.

The Lowell, Mass., Police Telegraph.—It was expected the new police telegraph system of Lowell, Mass., would be put into full operation Christmas eve, but owing to unavoidable delays only one of the five circuits was opened, the Belvidere circuit, comprising 18 boxes. By this time it is probable that the whole system is in successful operation. To operate the instruments in the station house the services of three men will be required, each to perform eight hours duty. Levi Brown and Officers McLaughlin and Grinnell have been appointed operators. Sundry changes in the day and night forces are also necessitated by these appointments. When the telegraph system is in good working order it is intended to have two teams in waiting both day and night for any calls for assistance that may be made.

THE TELEPHONE.

Spreading in Scotland.—For telephonic communication with Glasgow, Bo'ness and Falkirk the Grangemouth merchant traders have just arranged with the National Telephone Company.

Cheyenne, Wyo.—In our notice of telephone work at this point (Dec. 20) the name of the exchange manager was, owing to illegibility of the manuscript sent us, misread as Tiemax, when it should have been Tiernay. The length of line through Pole Creek, etc., is 79 miles, not "7 to 9."

Erie, Pa.—The exchange at Erie, Pa., has increased during the last twelve months from 174 subscribers to 317, a net gain of 143. The population of the city is 27,000. It would be interesting to know if this progress has been beaten anywhere. The manager of the exchange is Mr. J. H. Francis.

Titled Telephonists.—As "Telephone Engineers to the Queen," by appointment from the Lord Chamberlain, Messrs. Tasker, Sons & Co., of Sheffield, will hereafter proudly designate themselves. This honor was conferred in recognition of the satisfactory nature of the telephone work recently done by this firm at Balmoral, Abergeldie, Ballater and Windsor.

In Colombia.—Jose R. Martinez, to whom was granted a telephone concession for Colombia, S. A., has handed it over to the *Compañía Colombiana de Teléfonos*, of which he remains the general manager. The subscription is $60 per annum, or at that rate by the month. Overhead wires are used, and communication is open for business and with the fire and police stations at all hours of the day and night.

In the West Indies.—Port of Spain, capital of the island of Trinidad, is jubilant at the prospect of a telephone exchange. The *New Era* says it will, no doubt, be a welcome piece of news to the numerous subscribers who are pledged to support the new undertaking prompted by Mr. A. W. Gray, to learn that the movement is now placed beyond the pale of mere speculation. It is fully expected that the system will be in operation in the early part of January.

Telephone Rates.—In the following European cities and countries the rate of subscription to the Telephone Exchange is: London, $100; Paris, $120; Riga and Odessa, $125; Austria, $45 to $75; Germany from $50, with an increase of $11.40 for every kilometre (1.86 miles) over two; Italy varying from $25 to $35 [illegible] way, $20 to $40 according to distance; Holland, $50; Portugal, $75 for traders and $35 for private individuals; Switzerland, $20 to $50.

In Paris.—It is rumored that the Société des Téléphones is trying to obtain from the Paris Municipal College a reduction from the rent charged on telephone lines, and also a continuation of the permission to fix wires in the sewers instead of overhead, while holding out the hope of giving increased facilities to the public in the shape of "call" offices. The French Minister of Posts and Telegraphs, while recently prolonging for five years the present concession of the company, stated that he would not refuse a similar concession to a competing company offering adequate guarantees.

As a Man and Official.—Mr. Henry D. Lyman, who resigned the high position of Second Asst. Postmaster-General to become Vice-President of the Bell Telephone Company, in his letter tendering his resignation, says: "I embrace this opportunity to thank you for the confidence reposed in me and to express the hope that the branch of the service with which I have been intrusted may never lack the interest I have felt in it, nor the economy in its management impressed upon it during your Administration." Postmaster-General Hatton, in acknowledging the receipt of Mr. Lyman's letter, says: "I would be loth to accept your resignation did I not understand that it is your desire and purpose to engage in other business. In accepting it, permit me to express my high appreciation of the ability and fidelity you have always displayed as a public officer and my hope that prosperity and success may attend you in private life."

What Was It?—The Manchester *Enterprise* of Dec. 25 is responsible for the following: "Mr. Keech, Manager of the Ann Arbor exchange, telephones the *Enterprise* that at 4.15 Monday afternoon as he was at work in his office, having just set down the hand phone of the city board, every enunciator on the board, 100 in all, dropped. He and the operator on the state line looked at each other in blank astonishment for a few seconds, and then began looking for the cause, but at this writing they are unable to solve the mystery. No damage was done and from inquiry he can learn of no similar transaction anywhere, which strengthens his opinion that a meteor passed over the city or that it was caused by a strong current of electricity passing through the air. There was no sound excepting that of the enunciators dropping simultaneously. Who can explain what it was?"

Edison in a Telephone Patent Appeal.—The effect of the decision of the Supreme Court in the Hoe patent case, where it was held that an appeal did not lie from the Commissioner of Patents to the Secretary of the Interior, is now being tested in a motion pending before the Commissioner of Patents. In February last the Secretary reversed the decision of the Commissioner in the Patent Telephonic Interference case of Blake agt. Drawbaugh agt. Edison, and restored Edison to his position in interference, from which he had been displaced by the Commissioner. Drawbaugh's counsel now assert that the Secretary's decision in the case was nullified by the decision of the court, and that Edison is barred from the interference proceedings. Mr. Roscoe Conkling, representing Edison, on Dec. 30 made argument before the Commissioner, taking the ground that the Secretary was de facto judge at the time, and that sound practice required the Commissioner to support the decision.

THE ELECTRIC LIGHT.

Racine, Wis., has adopted the Thomson-Houston way of doing it, and her citizens are very much pleased thereat.

Very soon the people of Atchison, Mo., will have an opportunity to pass upon the merits of the Thomson-Houston system.

The Heart of London.—The Hammond Electric Light Company has been awarded a contract for lighting up a square mile in the city of London, at the very heart of business and trade.

In Antwerp.—An installation, to be completed by the 12th of February, has been authorized by the Antwerp municipality, for the lighting of the eastern quarter of that city by the electric light of the Brussels Compagnie Générale Electricité.

Brooklyn, L. I.—The Municipal Electric Light Co., of Brooklyn, E. D., have just broken ground for the erection of a new iron building, to be supplied with all the latest improvements for the generation of current for light. The company was formed less than one year ago, and started with 115 lights; the new station will have a capacity for 600 lights. The system used is the Thomson-Houston. The success of this company is due in a great measure to President Cooper.

A Chicago Dry Goods Store.—A. L. Ide shipped recently a 60 h. p. Ide automatic engine to the Davis & More Co., Chicago, for driving a 40 Excelsior light dynamo for their large dry goods store. The other 60-h. p. engine, which has been running constantly for the past six months, will now be used for driving two No. 6 Baker blowers which compress air to transmit cash carriers through a system of 2-inch glass tubes from the different departments to the cashier's desk.

Lancaster, Pa.—The State Department of Pennsylvania has granted a charter to the Merchants & Manufacturers' Electric Light Co., of Lancaster, Pa. The capital stock is $20,000. The Board of Directors are: W. K. Beard, H. F. Diller, C. F. Meyers, Dr. R. M. Bolenious and Geo. S. Brock. The company are going to put in a 40 arc light plant, using either the Remington or the Ball system. The power will be furnished by one of the Pennsylvania Diamond Drill Co.'s high speed adjustable cut-off engines—the same as used by the Pittston Electric Light Company, of Pittston, Pa. The U. S. E. L. Co., of Pennsylvania, are furnishing 125 arc lights to the city of Lancaster. This is their second year. They have about 25 miles of wire in their circuits.

What the N. Y. S. H. Co. Offer.—A communication from Washington says: The New York Steam Heating Company has offered the government a rental of $10,000 a year each for the basements of the New York Custom-House and Post-Office, in which to put its plant. The company agrees in addition to bind itself to supply the buildings with heat and electric lights free of cost. The heating and lighting now costs the government over $80,000 a year. Supervising Architect of the Treasury Bell has been investigating the matter, and, it is understood, will report against the leasing of the premises. He believes that the government will need the rooms, and that it would not be proper to enter into an arrangement that would give private individuals a foothold in those buildings.

MISCELLANEOUS NOTES.

For the Ice Harvesters.—Anticipating an untimely break-up of the ice in the Hudson, at Albany, the ice harvesters continued their operations at night on the nine-inch ice this week by the aid of electric lights.

A Not Unusual Experience.—Mr. Elisha Gray, now wealthy through his invention of electric instruments, used, so the story goes, to be a very unsuccessful farmer at Oberlin, O. He spent most of his time for several years in experimenting, and came to be regarded as a crank. His own family were inclined to take that view of him; and when one day he excitedly declared that he had devised "a self-adjusting helix," his wife hastily consulted with a physician about putting him under constraint.

To Secure Gutta Percha.—The rapid expansion of telegraphy makes it a matter of the greatest importance that there should be no diminution in the supply of gutta percha, a product which is indispensable to the electrician. There is much reason to fear, however, that such a diminution will before long be experienced. The demand for gutta percha is always increasing while the supply is falling off. The natives of Sumatra and the neighboring islands do not properly cultivate the gutta percha tree, and much of its produce is ignorantly wasted. One consequence of this is that, within a comparatively brief period, the price of gutta percha has trebled; another, and a very serious consequence, is that the falsifier has turned his attention in this direction, and has placed on the market many "worthless imitations." A short time ago, M. Seligmann-Lui was deputed by the French Government to consider in what manner the production might be increased, and in the report which he has lately made he recommends that plantations should be established of trees which yield the best gutta percha. As the cultivation of these trees is very profitable, the English, French and Dutch Asiatic colonies would find an assured source of revenue in growing gutta percha.

APPLICATIONS OF POWER.

A Seaside Electric Railway.—Articles of incorporation have been filed in the Queens County (N. Y.) county clerk's office by a company which propose to run an electric railway from Far Rockaway to the Long Island Railroad. The capital is fixed at $200,000.

French Fancies.—The *Compagnie Electrique*, of Paris, is furnishing generating machines for various domestic uses; one of these at a leading restaurant drives knife-cleaners, bottle washers and floor-polishers during the day, and in the evening causes the carbon filaments to glow. A company called "Le Chrôme" has been formed in Paris for supplying and maintaining, by contract, special chromic acid batteries for lighting and for innumerable industrial applications.

STOCK QUOTATIONS.

Telegraph, telephone and electric light quotations on the New York Stock Exchange, Boston Exchange, and elsewhere, are as follows:

TELEGRAPH.—Am. Cable, b 51¼ a 53; B. & M., b 2 a 4; Mutual Union, b 12½ a 14; Postal Stock, a 3; Postal sixes, b 20 a 23½; Western Union, b 55¼ a 55⅝.

Am. Cable is low on account of the new Commercial Cable competition, Western Union on account of land competition. People are asking how the B. & O. Company can make money on a 15-cent rate to Chicago. It is a close shave, anyhow.

TELEPHONE.—Am. Bell, b 243 a 244; Erie, b 19 a 20; Mexican, b 1⅝; New England, b 34½ a 34¾.

The Boston *Herald* of Jan. 7 says: Bell telephone fell back to 240, and reacted to 243 at the end of the morning board. Sundry rumors are current to explain the decline. It is averred that the McDonough suit may work harm, which it cannot so long as the Bell people have a "mortgage" on whatever of value the inventor may be proven to possess; that the new Philadelphia telephone may prove an important rival and does not infringe the Bell patents. There is no new development in that direction. The Dolbear telephone suit is coming up in April, and from this source there is little or nothing more to fear than there has been in the past. The truth probably is that parties who bought Bell stock at 250 and upward, expecting it to reach 300, and who did not realize, now find it necessary to sell. The market is oversupplied, and down goes the price. It was, perchance, carried a little too high after the Drawbaugh decision. Other telephone stocks sympathize.

ELECTRIC LIGHT.—No new quotations. A dispatch from Boston says: There is an active demand for both the preferred and common stock of the American Electric and Illuminating Company, and much higher prices are talked. The management is squaring itself for an active and aggressive business campaign for the year 1885, and it is claimed that the past success which the company has met with has stimulated the directors, many of whom are numbered among the most successful business men of New England, to make a determined push for supremacy in the electric lighting business throughout the country. There is no doubt about the company occupying a much stronger position than the general public has given it credit for. One thing is certain: President Goff has the hearty and unanimous support of his directors and business associates, all of whom now unite in indorsing his management, and assuring him of cordial financial support in the future. The common stock, which has so long suffered from the prevalent depression, is showing signs of renewed activity. The preferred is also in increased demand, and though it has never fallen so low as the common yet, the present quotations are manifestly no fair price for a 12 per cent. stock.

It is said that certain parties hitherto prominent in bearing stock are now anxiously wiring and writing to out-of-town correspondents to pick up all the small lots possible. The common has advanced from 95c. to $1.25, and $2 is talked within 10 days. The preferred is in active demand at $7, and $10 will no doubt be reached within the next two weeks.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS DATED DEC. 23, 1884.

Armature for Dynamo-Electric Machines; B. F. Orton, East Saginaw, Mich..... 309,735

Consists of a ring or cylinder armature built up from thin plate-iron in superposed layers, bent or curved to the form of the armature, and having interposed separating-pieces of magnetic material for separating the superposed layers, so as to leave transverse or lateral air-spaces through the body of the armature.

Autographic Reed-Telegraph; A Brooks, Brooklyn, N. Y..... 309,600

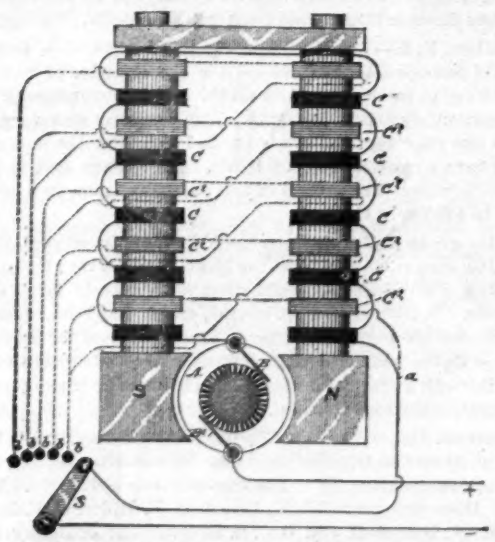
Consists of a local circuit including a reed, a rider, and a strip of conducting material capable of discoloration by a current of electricity, said reed being caused to vibrate in response to electrical pulsations transmitted over the line-wire from the sending terminus.

Armature for Dynamo-Electric Machine; B. F. Orton, East Saginaw, Mich..... 309,560

Consists of an armature, two or more of whose coils in the same general armature plane have their same ends connected to the same portion of the commutator on one side thereof, while their opposite ends are connected to two or more coils in the same general plane similarly connected to the commutator on the opposite side thereof.

Regulator for Electric Generators and Motors; Walter K. Freeman, Brooklyn, N. Y., Assignor to Monarch Electric Company of New York..... 309,536

By turning the switch S the strength of the field-magnet may be gradually cut down as the number of opposing coils C^2 in circuit with coils C is increased, thus diminishing the electromotive force of the machine if it be used as a generator, and its speed if it be



used as a motor. The number of the coils C is the normal or maximum number employed for giving to the machine its normal or maximum capacity as a motor or a generator. The switch S normally, or when on the right-hand contact-stud, completes the circuit from the charging-coils directly to line, but if turned to the left breaks such connection and compels the current passing through the charging-coils to pass through one or more pairs of opposing coils C^2 before reaching line, thus cutting down the field-magnetism to an extent dependent on the number of coils C^2 in circuit.

Circuit-Closer for Electric Alarms; A. Lungen, New York, N. Y., Assignor to Edwards & Co., New York City..... 309,790

Consists of a combination of springs, cams, levers, eyelets, insulating rings, etc., to be used for breaking and closing circuits when windows are broken into by thieves.

Electrical Apparatus for Operating Bolts; W. Vogel, Chicago, Ill..... 309,585

Consists in the combination of a door, one or more bolts or other fastening devices which are attached to an armature or armatures, suitable connecting-wires, battery, endwise-moving permanent magnet or electro-magnet, and a circuit-closer

Electric Motor; C. C. Peck and W. H. Chapman, Middlebury, Vt., Assignors to the Chapman Electric Motor Company of New York..... 309,562

Consists in the arrangement of two or more magnets or armatures in a circle, and of one or more armatures or magnets adapted to roll on the surfaces of the former, and so adjusted as to produce a continuous rotary motion of a shaft to which one group, either of the magnets or armatures, is attached.

Electric Motor; W. H. Chapman, Middlebury, Vt., Assignor to the Chapman Electric Motor Company, of New York..... 309,522

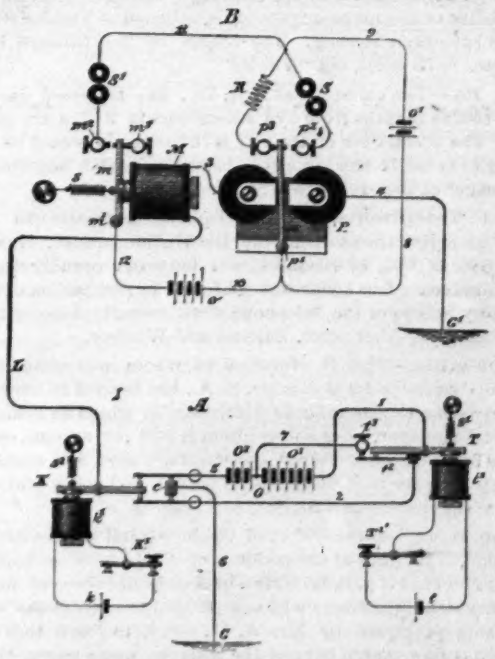
Consists of two cylindrical magnets arranged to revolve on their own axes and to roll on the surface of a drum, composed of alternate sections of magnetic and non-magnetic material, the segments of magnetic material being of suitable length to cover the arc included between said magnets, and thus to connect them at one point during each rotation.

Electric Railway; F. H. Danchell, Maidstone, County of Kent, England (patented also in England and France)..... 309,606

My invention consists of an electric-motor carriage or locomotive having wheels for running on a lower track, guide-wheels for running against an upper lateral current-conducting guide-way, elastic current-collecting appliances, a motor having a driving-wheel on its spindle, located centrally between two driven bearing-wheels and adjustable frictional driving contact appliances.

Means for Preventing False Signals on Reversals in Quadruplex Telegraphs; A. Van Hovenbergh, Elizabeth, N. J..... 309,751

When the pole changer K is operated, it is evident that there will be an instant at each reversal when there is no current upon the main line. At this instant the spring S of the neutral relay M will begin to draw the armature-lever m toward the stop m^3. The polarized armature p of the relay P will remain against one



of the stops, p^3 or p^4, for it will not move until the reversed current begins to act. Before the armature-lever m, however, has reached the stop m^3 the armature p will have left its stop and will be on its way between its two contact stops. When in this position, no false signals can be given upon the sounder S', for the following reasons: The local batteries o and o' have their positive poles opposed to each other. The battery o consists of two elements in series. The battery o' consists of one element only—that is, the battery o has twice the electromotive force of the battery o'. The sounder S is adapted to respond to the current of the battery o' of one element. The sounder S' is adjusted to respond only to the full current of the battery o of two elements. When the armature p is in its middle position, therefore, the current from the battery o, passing through the wires 10 and 8 to the battery o', is reduced to half its strength thereby, and, passing by the wires 9 and 11 to the magnet S', and then to the other pole of the battery o', is insufficient to work the sounder S'.

Means for Overcoming Static Disturbances in Telegraphy; C. Selden, Baltimore, Md..... 309,572

Consists in the combination, with a suitable polarized reading or repeating sounder having an unbiased armature lever, of suitable means operating simultaneously with the occurrence of the static charge and discharge current to render the local battery for the sounder ineffective upon the latter at the instant of such charge and discharge.

Illuminating Point for Electric Lights; C. F. Brush, Cleveland, Ohio..... Reissue 10,544

Consists in using very small carbon electrodes covered with electrolytic copper.

Means for Overcoming Static Disturbances in Telegraphy; C. Selden, St. Louis, Mo..... 309,571

Consists in overcoming the effect of the return or discharge current by an auxiliary magnet arranged to pull in mechanical opposition to the relay, and brought into action at the proper time by any suitable automatic device acting synchronously with the movements of the transmitter to close the circuit of the local battery through it.

Microphone; J. Semal, Belgium (Patented also in Belgium, France, Italy, Austria, Hungary and England)..... 309,742

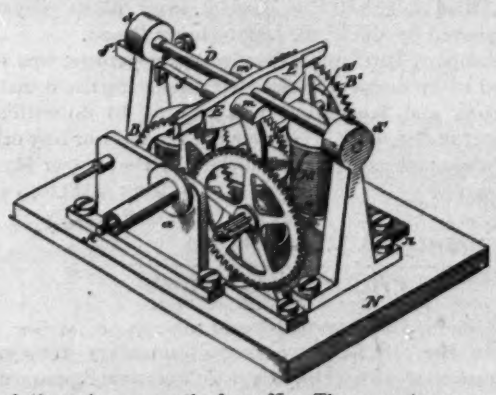
Consists of a vibratory diaphragm, two cylindrical electrodes secured to the diaphragm in proximity to each other, and a circular electrode bridging the space between the two cylindrical electrodes, and in superficial contact with the exterior and convex surfaces of both the latter.

Telephone Call-Box; Elisha Gray, Chicago, Assignor, by mesne assignments, to the Western Electric Company, Chicago, Ill..... 309,617

Consists of the driving-shaft of a dynamo or magneto electric machine; a sleeve mounted thereon in such manner as to have a determinate longitudinal movement thereon; and a circuit-breaker automatically operated by the longitudinal movement of the sleeve.

Secondary Electric Clock; G. Trippen and F. Trippen, Jr., Philadelphia, Pa..... 309,809

The rocking lever E carries two armatures m m', which are acted on by the two pairs of electro-magnets M M', mounted on



an insulating piece n, on the base N. The armatures m m' are preferably mounted on the lever E, near the shaft D, and the polar extensions of the electro-magnets are bent inward correspondingly, to act on the said armatures.

Quadruplex Telegraph; Charles Selden, Baltimore, Md..... 309,573

When both transmitters are "open," a current of a determinate strength and positive flows to line and keeps both local circuits and sounders open. When one transmitter is closed the tension of the normal current is so far reduced as to permit a spring or springs whose tension is overcome by the normal current to act and close one of the locals at the receiving end of the line. When the other transmitter is closed, a current of a definite strength, but of opposite polarity to the normal current, flows to line and acts upon the polar relay to throw its armature in the opposite direction, so as to close the local of the other sounder, but to also close a circuit which shall render the first sounder inoperative. When both transmitters are closed, an increased current of the same polarity flows to line and keeps the circuit of the second sounder operative, but moves the lever sufficiently far against the tension of a spring to break the circuit or contact employed for rendering the first sounder inactive under the last-named condition, thus causing both sounders to respond.

Telephone Switch; J. D. Lyle, Columbus, Ind..... 309,701

Consists of a sliding spring-actuated bar which is projected by its spring into the supporting-hook when the telephone is detached, and pushed back by the telephone in placing it in the hook.